Final Report

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Naval Exchange Gas Station
Underground Storage
Tank (UST)
Spill Investigation

Submarine Base New London Groton, Connecticut

United States Department of the Navy Naval Facilities Engineering Command Northern Division

October 1990







October 4, 1990

Mr. Brian Helland, Code 1412 Department of the Navy NAVAL FACILITIES ENGINEERING COMMAND Northern Division U.S. Naval Base Building 77-L Philadelphia, PA 19112-5094

RE:

Final Report, UST Spill Investigation,

Naval Exchange Gas Station New London, Connecticut

FILE:

1862,023

Dear Brian:

Please find enclosed five (5) copies of the above-referenced report. This report was completed under Contract #N62472-88-D-1448 in accordance with Amendments 10 and 13 dated October 18, 1989 and May 1990, respectively.

It is recommended that this report should be submitted to the CTDEP and a "No Action" alternative should be sought for the soil and ground water contamination. If the CTDEP accepts a "No Action" alternative, they will probably require a long-term monitoring program to be implemented at the site.

Mr. Brian Helland October 4, 1990 Page 2

If you have any further questions regarding this report, please do not hesitate to call me.

Very truly yours,

O'BRIEN & GERE ENGINEERS, INC.

Edward P. Zimmerman

Senior Project Engineer

EPZ/brg

Edwards

Enclosures

cc: W. Mansfield, Sub Base New London DPW (5 Copies)

T.A. Jordan

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NAVAL EXCHANGE GAS STATION UST SPILL INVESTIGATION NAVAL SUB BASE NEW LONDON, GROTON, CONNECTICUT

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SECTION 1 - INTRODUCTION

1.01 - Project Background

The following report has been developed from investigations concerning the nature and extent of a gasoline release at the Naval Exchange Gas Station, Building 428, Submarine Base New London (SUBASENLON), Groton, Connecticut. Figure 1 illustrates the location of the Exchange Station on the Base. On October 10, 1989, gasoline was discovered in storm sewers adjacent to the Naval Exchange Gas Station. Emergency testing of three underground gasoline storage tanks and pipelines beneath the facility was conducted on October 11, 1989. Figure 2 illustrates a detailed map of the Exchange Station and the storm drain system. A significant leak was discovered in a crash valve located in the south dispenser pump on the second island from Building No. 428. When the crash valve was closed, gas was observed to leak at a rate of 2-4 ounces per minute. Originally, a crash valve at this site was observed by mechanical contractors to be malfunctioning on February 21, 1989. A new valve was installed and it appeared to function properly. This new valve which was removed on October 11 contained a crack in its housing which facilitated the leak.

Available records also indicate that on October 11 a capped vertical pipe at dispenser island No. 1 was also found to be leaking slightly. On October 13, this cap was replaced with a bleeder valve to allow air to be released from the system. All other pipes and tanks were determined to be tight based on hydrostatic testing by Pasquallini Inc.

After the leak was identified, a baffle and weir was installed in catch basin No. 4 to collect some free-phase gasoline floating on the water surface. A small volume was collected during the period when vapors were noted.

The gasoline noted in the storm drains occurred at a time of low flow conditions. A period of heavy rainfall occurred immediately thereafter and very little or no gasoline was noted in the drains as observed through the catch basins shown on Figure 2. Most recent observations made during a subsequent period of low flow indicated only minor sheens and vapors in the affected basins.

Based on these observations and the recent piping work at the facility, it appears that the release occurred over a relatively short period of time before it was noticed. Station reconciliation records indicate no loss greater than 0.5% over the period of time prior to discovery of the leak. No estimate of volume of lost product could be made.

1.02 - General Site Conditions

The Naval Exchange Gas Station is located on the southern end of the Base on a relatively flat area near the Thames River which flows by the Base about 1,250 feet to the west. Surface topography around the station is also relatively flat and ranges in elevation from 22 to 26 feet (USGS mean sea level datum). Topography decreases locally toward the catch basins and primarily toward catch basin No. 1 on the southeast corner of the facility. Surface water runoff from paved portions of the station is directed toward the network of catch basins which traverse the station (Figure 2). Discharge from these basins is comingled with other surface drainage in the area and blow off from an oil condensing unit prior to outfall at a boomed outlet at the Thames River.

Geographically, the station is located in an area which formally contained a lake between two outcrops of rock to the northeast and southwest. The lake, which was historically known as "Crystal Lake", was reportedly dredged and filled in with upland soils to create a level surface for development of the Base. As a result, soils in the area contain an upper layer of fill which is variable in thickness and which overlies naturally occurring fine sand, silt, and

organic silt of the former lake bed. On-site, the fill thickness varies from a few feet to approximately 15 feet and is thicker around underground tanks and storm water drain pipes.

Additionally, the backfill used for these structures is probably of higher permeability than the fine grained, natural soils surrounding them. This is probably a contributing factor to the gasoline observed in the storm water sewers.

1.03 - Project Objectives and Scope

The purpose of this program was to characterize the extent of the gasoline release in the subsurface in the area of the exchange station and to define the mechanisms by which the gasoline is entering the storm water drainage system. Another goal of the program was to estimate the amount of non-aqueous phase product on the water table and the extent and type of dissolved petroleum hydrocarbon residues in the ground water.

The nature of the data gathering phase of this program was flexible and comprehensive to allow for modifications to the field investigations as the program proceeded. Modifications that were needed, i.e. soil borings/monitoring wells were communicated verbally and in writing to Navy personnel. Authorization was sought from the Navy prior to the implementation of additional investigative efforts.

By incorporating field modifications into the strategy of the field program, sufficient information for the screening and selection of an appropriate remedial plan of action was obtained.

SECTION 2 - FIELD INVESTIGATIONS

<u>2.01 - General</u>

Field investigations were performed in separate phases between the period of December 5, 1989 and July 30, 1990. Field investigation methodologies were consistent with those described in the "Plan of Action" (POA), "Naval Exchange Gas Station Underground Tank

(UST) Spill Investigation and Remedial Design," dated November 1989. Field work consisted of the installation of a total of nine soil borings and subsequent monitoring wells. Grab sampling of surface water at four catch basins (two rounds), soil sampling, ground water sampling, air sampling, sampling of the outfall area, manhole inspecting, and an elevation survey on-site were also conducted.

2.02 - Health and Safety Plan

A Health and Safety Plan (HASP) was developed for implementation during the field activities. The Health and Safety Plan presented in Appendix A is written in accordance with OSHA 29 CFR 1910 regulations for hazardous waste operations and emergency response. The plan specifies the protective equipment required for site investigators and visitors to minimize exposure to potentially hazardous materials.

The plan also specifies contingency plans for dealing with emergencies and other potential site hazards. A brief toxicological assessment of chemicals used on-site relative to potential effects which they might present to site workers at concentrations expected to be encountered during field work was presented in the plan.

2.03 - Interim Sampling Results

An interim sampling effort was conducted prior to initiation of the drilling program to provide more substantive information regarding the point at which contaminants are entering the storm drain system. This information assisted in developing the amount and placement of borings and monitoring wells discussed in upcoming sections of this report.

Grab samples of surface water at four catch basins around the station were collected on November 14, 1989 during low or "base flow" conditions according to the procedures in Appendix B. The catch basins sampled included No.'s CB-1, CB-4, CB-5 and CB-7, shown on Figure 3. Two inlets at catch basin No. 1 were sampled and were designated CB-1A and CB-1B for the purpose of denoting sampling locations. Sampling location CB-1A was at

CB-1 at the inlet from CB-6 and sampling location CB-1B was at CB-1 at the inlet from CB-7. The purpose for collecting the samples during low flow conditions was to obtain water quality data at specific points representative of potential ground water infiltration into the drains. Sampling during storm or high flow conditions would tend to mix and dilute the samples at each point.

The samples were observed for visual contamination (immiscible layers, sheens, etc.) and odors. This information was documented on a sampling log for each site as included in Appendix C. Samples were properly containerized and shipped to Toxikon Environmental Laboratories of Woburn, Massachusetts for analysis of volatile petroleum hydrocarbons (EPA Method 503.1) and Total Petroleum Hydrocarbons by infrared spectrophotometry (EPA Method 418.1). The chain-of-custody form is presented in Appendix D. Laboratory analyses were scheduled for a four-day turnaround to facilitate incorporation of the data into the proposed plan of action. A quality assurance/control trip blank analyses for volatile hydrocarbons was also performed but at no extra charge by the laboratory.

Samples were collected by lowering a glass jar into the stream at each point. Oxygen levels noted in the basins during sampling were normal at 20 to 21%. No carbon dioxide or hydrogen sulfide was noted. Visual observations during sampling indicated clear water with no sheens or odors at the upstream basin CB-7. The following was noted at the two inlets to the next downstream basin CB-1, at sampling location CB-1B: strong gasoline odors with possible emulsified product was noted (downstream of the product loss area), no odors or sheens were noted in sampling location CB-1A from upstream basin CB-6. Slight sheens with very little or no odors were noted at two other downstream basins CB-4 and 5.

2.04 - Soil Borings

Nine test borings (OBG 1-9) were performed for the purpose of collecting and analyzing soil samples and for placement of monitoring wells such that an approximation of the extent of

soil and ground water contamination, could be made. Boring locations are depicted on Figure 4.

Due to the potential for encountering a subsurface utility, special care was required in advancing boreholes through the upper 3 to 4 feet. Coring of concrete was necessary at OBG 1, 2 and 4. All borings were initially hand excavated to a depth of 3 to 3.5 feet to confirm the absence or presence of subsurface utilities. Following hand excavation, continuous splitspoon samples were taken utilizing a 24-inch long by 2-inch outside diameter sampler. Samples retrieved were visually logged and classified by an OBG Hydrogeologist, placed in laboratory approved jars and were field screened for total organic vapor content by a photoionization detector (TIP) calibrated to a benzene equivalent using a 10.6 EV lamp. Samples selected for analysis were submitted, based on these field screening results and visual observations.

Borings were advanced using 4 1/4 inch hollow stem augers to a total depth of between 14 and 18 feet. Between soil sampling events, split spoons were decontaminated with a low phosphate soap wash followed by a tap water rinse, methanol rinse, and a final distilled water rinse. Hollow stem augers and drilling equipment were decontaminated between borings by a high pressure steam cleaner. Excavated soils and cleaning fluids were containerized in labelled 55 gallon D.O.T. drums for disposal by NAVFAC. Soil boring protocols and boring logs can be found in Appendices B and E, respectively.

Samples exhibiting the highest organic vapor content were submitted for analysis of Volatile Petroleum Hydrocarbons (EPA Method 8010/8020) and Total Petroleum Hydrocarbons by IR, (EPA Method 418.1). In addition, soils which appeared to contain non-aqueous phase product were submitted for total petroleum hydrocarbon analyses by GC/FID methods. Quality assurance/control analyses for soils were performed by routine lab analysis of matrix spikes and duplicates. Results of the analytical data are explained in Section 3.04 "Analytical Results" and raw data can be found in Appendix D.

2.05 - Monitoring Well Installations

Upon completion of the soil borings, monitoring wells were installed on-site for the purpose of :1) ground water elevation monitoring for ground water flow direction estimations, 2) hydraulic conductivity testing for ground water velocity calculations, 3) determining the thickness of any non-aqueous phase floating product and 4) water quality evaluations. Well installation procedures and specifications can be found in Appendix B and E.

Each well consisted of ten feet of 2" inside diameter PVC screen and a suitable length of solid riser to bring the well to ground surface. Well screens used at OBG-1 and OBG-4 were a No. 20 slot size screen. These wells, installed initially, were found to allow a greater quantity of the natural formation to enter the well screen than was desired. To minimize this occurrence, slot size openings were reduced to a No. 10 slot size screens.

Upon setting the PVC in each well, washed silica was placed around and two feet above the screen followed by a 2 foot bentonite pellet seal. The remaining annulus was filled with a bentonite/cement grout. A flush mounted, locking protective cover was then placed over the well to protect it from disruption by vehicular traffic and unauthorized entry.

Following installation, the wells were developed by use of stainless steel bailers and new polypropylene rope at each well. Development continued, until the discharge water appeared relatively free of sediment. Equipment used during development was decontaminated between wells, by a methanol rinse followed by a distilled water rinse. An elevation survey of well points and other structures relative to an on-site datum was performed at the conclusion of well development. The top of PVC and ground surface were surveyed at each well location. The ground elevation at the north rim of CB-1 was taken to be 100.00 feet. In addition, the ground elevation at catch basins CB-1, CB-5 and CB-7 together with ground elevations at certain locations around the site were taken for control purposes.

2.06 - In-Situ Hydraulic Conductivity Tests

Hydraulic conductivity tests were performed in each of the monitoring wells. Stainless steel bailers were used to purge the wells in order to impart a sufficient drawdown. Water level readings were then collected as rapidly as possible during recovery until the major portion of the water column had recovered. Attempts made to record data at monitoring wells OBG-1 and OBG-2, were insufficient because recovery rates were nearly instantaneous.

The data was then plotted using Hvorslev's method of analysis for a piezometer in an unconfined aquifer, "Groundwater", Freeze and Cherry, 1979. Data pertaining to the hydraulic conductivity tests performed at OBG-3 through 9 can be found in Appendix F. The procedures for conducting the tests and evaluating the data are presented in Appendix B.

2.07 - Surface/Ground Water Sampling

2.07.01 - Supplemental Surface Water Sampling

On December 15, 1989, a second round of surface water samples was collected from catch basins CB-1, CB-4, CB-5 and CB-7 which coincided with the first round of ground water sampling from the wells. The sampling methods were the same as that used in the interim round. These samples of surface water were also collected during low flow conditions. Two inlets at catch basins CB-1 were sampled and were designated 1A and 1B. Samples were collected by lowering a glass jar gently into the effluent pipe in question. It was described and noted if contamination, odors, and suspended debris were present in the samples. Samples were then properly containerized and shipped to Toxikon Environmental Laboratories for analysis of volatile hydrocarbons and total petroleum hydrocarbons. A quality assurance/control trip blank accompanied each round of samples and was analyzed for volatile petroleum hydrocarbons.

2.07.02 - Ground Water Sampling

Two rounds of ground water samples were collected. Ground water samples were collected from the initial six monitoring wells to provide on-site ground water quality data. Samples were analyzed for volatile petroleum hydrocarbons, total petroleum hydrocarbons and a GC fingerprint scan run from non-aqueous phase product collected from two wells (OBG-1 and OBG-2). Product thicknesses in these wells during this time varied from one to three inches using multiple measurements with a product bailer. Ground water sampling methods were consistent with those described in Appendix B.

A second round of ground water samples was collected from the three supplemental wells (OBG-7 through 9) on June 27, 1990. These samples were also submitted for volatile petroleum hydrocarbons and total petroleum hydrocarbons using methods described above. Ground water sampling logs can be found in Appendix G.

SECTION 3 - FINDINGS

3.01 - Surficial Characteristics and Ground Water Use

The land surface at the Naval Exchange Gas Station is essentially flat with a very slight topographic slope of less than one foot from north to south. The ground surface has been graded to slope toward individual catch basins.

The Base is located on the east bank of the Thames River about 6.5 miles upstream of the mouth. All surface drainage from the Base is westward into the Thames through an extensive storm water collection system. This drainage system is continuous through the Naval Exchange Gas Station.

According to: "The Master Plan" there is no ground water development on the Base since Groton provides all potable water from surface water supplies. However, areas north and northeast of Base such as Ledyard, are dependent on ground water for their potable water. Ground water in the area can be obtained in stratified glacial outwash deposits, glacial till and bedrock. Depth to ground water on Base will vary depending on the source but is generally less than 10 feet below the surface. At the Exchange Station, the ground water is about 9 to 10 feet below ground surface.

3.02 - Subsurface Geology

The area in which the Base lies consists of soils of the uplands, terraces and flood plains, all of which may be found within the Base perimeter. The upland areas are characterized with soils that vary from well drained to poorly drained with slopes in many areas exceeding 15% and in some areas exceeding 30%. The terrace area in which the Exchange Station is located are generally characterized with poorly to very poorly drained soils deposited in a former lake or estuary. For urban use, these soils have severe limitations and restricted drainage and land fill measures are necessary to overcome the high water table. These fill measures are evident at this Naval Exchange Gas Station where fill material is comprised of three distinct units: 1) Dark brown, fine to medium sand/some fine gravel and silt, 2) Light gray-white, fine sand-silt and, 3) Pea gravel (located around the tanks).

Fill depths varied dramatically across the site. Fill depths near the UST's were observed at a depth of 16.5 ft. Fill depths away from the tanks varied from 4 to 7 feet. Information from OBG-6 revealed a fill depth of 10.5 feet, but this is believed to be due to the UST located to the north.

Natural material consisted of two distinct units, Dark brown/black, fine silt/some fine sand/trace amounts of vegetation (roots, etc.) and Light gray, fine sand-CS-silt". The "dark brown/black zone, viewed as an organic silt layer, is believed to represent lake bed, or estuarine sediments. The earth material below this zone, consisting of light gray, fine sand-CS silt, is well sorted and believed to be a glacial outwash deposit of the Pleistocene epoch.

Bedrock was not encountered during monitoring well installations, but is believed to be not far below the organic silt zone. This is based on the nearby geography and outcrops located close by to the northeast and southeast.

The bedrock underlying the Base consists of meta-sedimentary and meta-igneous layers which dip steeply to the northeast and make up the leg of the overturned Quaker Hill Anticline. These rocks exhibit many episodes of minor folding and faulting as well as high grade and retrograde mineralogic assemblages.

3.03 - Ground Water Occurrence, Flow Direction, and Velocity

The first zone of saturation which represented the ground water table was found at a depth of about 9 to 10 feet below grade. The fluctuation of the ground water table observed through four monitoring rounds collected from December 1989 to July 1990 (see Table 1), indicated a fluctuation of not more than 0.2 feet downward during this time.

Several rounds of ground water elevations were collected at the site because water levels appeared to be complicated by the presence of soils with varying permeability, free product layers, and drains. The third and fourth rounds collected in January and July 1990 were contoured as shown on Figures 5A and 5B. The presence or absence of contamination and proximity of wells to subsurface drains was used to help interpret the data. Using this with the flow data presented in the Fuss and O'Neil report indicated that the ground water flow is convergent toward Tang Avenue and then generally to the west (Thames River), as was previously expected. The local reversals at wells OBG-3 and OBG-6 is probably due to the fact that the water table is lowered in this area by leaky drain pipes, cistern or sewers near CB-1 and OBG-6.

Hydraulic conductivity values at wells OBG-3, OBG-4, OBG-5, and OBG-6 around the fuel islands and gas tanks ranged from 0.076 to 0.35 ft/day and were representative of fine sand and silt deposits. Hydraulic conductivities on the western side of the site around wells

OBG-7, OBG-8 and OBG-9 were slightly higher once again and ranged from 0.48 to 5.5 ft/day. These values were consistent with coarser grained coarse to fine sand deposits which were noted during borings for these wells. The hydraulic conductivity of the pea gravel around the tanks near OBG-1 and OBG-2 could not be recorded. Based upon literature values cited in "Applied Hydrogeology" by Fetter (Page 75), the hydraulic conductivity of well sorted gravel can range from 30 to 3,000 ft/day.

An estimate of the range in ground water velocity (Vs) was made from wells OBG-3 through OBG-9 and the ground water flow maps. The hydraulic conductivity values for OBG-1 and OBG-2 in the gravel fill were not used here. These values may be applied for calculating ground water withdrawal rates and cones of influence if remediation of this type is warranted for the gravel fill zone around the tanks.

The natural ground water velocity for the soils outside of the gravel fill zones was estimated by use of Darcy's equation and an estimate of effective porosity and is given as:

$$V_{S} = \frac{Ki}{n}$$

where:

K = hydraulic conductivity (ft/day)

i = hydraulic gradient (ft/ft)

n = effective porosity

The hydraulic gradient delineated from the two maps varied between about 0.007 and 0.01 and averaged about 0.009 ft/ft. The effective porosity was estimated to be 0.2 for sand (Cleary R.N., 1984). Based on this information, the velocity of ground water was estimated to be from 0.003 to 0.24 ft/day. Ground water and contaminant velocities will likely vary significantly due to the varied types and grain sizes of soils around structures, tanks, etc.

3.04 - Analytical Results

3.04.01 - Surface Water Sampling

Analytical results from the interim surface water sampling support visual observations and are presented in Appendix D and Table 2. These results indicate non-detectable volatile or total petroleum hydrocarbons concentrations in the upstream basin CB-7. Elevated concentrations of aromatic volatile hydrocarbons typical of those found in unleaded gasoline were detected in at sampling location CB-1B downstream from the area of the gasoline release. These compounds consisted of benzene, trimethyl benzene, butylbenzene, toluene and xylenes. TPH values were detectable but somewhat less indicating that hydrocarbons present consisted almost wholly of those mentioned above.

Much lower but detectable volatile hydrocarbon concentrations were also noted at sampling location CB-1A and other downstream basins CB-4 and CB-5. No detectable TPH values were noted in these basins. These lower values represent a mixture of impacted influent at sampling location CB-1B and unimpacted influent in at sampling location CB-1A. A quality assurance analysis of trip blank indicated non-detectable concentrations.

The analytical results support the assumption that gasoline infiltrated the storm drain between basins CB-7 and CB-1. Results of the second surface water sampling on December 15, 1989, indicated generally the same concentrations in all sampled basins except a notable decrease in concentrations at the most contaminated basin (CB-1). No oil film or sheen was noted during this period which indicated no migration of free phase product into this basin at this time. In fact, no free phase product or vapors have been noted since the initial release in October 1989.

3.04.02 - Soils

Analysis of organic vapors from soil samples collected from the borings indicated the presence of organic vapors, and some petroleum staining, in every boring except OBG-3, OBG-7 and OBG-8. Soil samples collected at and above the water table submitted for analysis of volatile petroleum hydrocarbons and Total Petroleum Hydrocarbons generally confirmed this finding. Volatile constituents consisting of benzene, ethylbenzene, toluene, and xylene (BETX), compounds were detected in soil samples from borings OBG-1, OBG-2, OBG-5, OBG-6, and OBG-9. The highest concentrations were found in boring OBG-2, OBG-6, and OBG-9 at depths of 6 to 11 feet, (see Table 3). Only petroleum hydrocarbon concentrations likely due to heavier weight fuel oils were found in boring OBG-4, OBG-7 and OBG-8. A map presenting the concentrations of total petroleum hydrocarbons in soils is shown on Figure 6. As can be seen on this figure, concentrations of total petroleum hydrocarbons in unsaturated soils appear to be greater than 100 mg/kg (dry weight) in the location and to the southwest of the gasoline storage tanks. Additionally, more localized contamination is evident around wells OBG-7 and OBG-8.

A fingerprinted concentration in soils representing gasoline was found in borings OBG-1 and OBG-9, each near gasoline islands. Kerosene and diesel oil was found at OBG-6. Samples weren't fingerprinted in borings OBG-2, OBG-3, OBG-4, OBG-0BG-5, OBG-7, and OBG-8.

3.04.03 - Ground Water and Product Sampling

During the placement and subsequent inspection of the first four monitoring wells (OBG-1-4), significant odors and a free phase product accumulation were noted at the ground water interface in wells OBG-1 and OBG-2. Several inches of dark colored, non-viscous, weathered gasoline were noted in wells OBG-1 and OBG-2 which were installed in a pea gravel around newly installed underground gasoline storage tanks. No visual contamination was noted at OBG-3 located near affected

catch basin CB-1. Only a trace of contamination was noted during sampling in OBG-4 near the crash valve leak and a sheen was also noted in the water surface in wells OBG-7 and OBG-8.

Results of the ground water quality data are shown on Table 4. It should be noted that per the Scope of Work, a round of water samples was collected in December 1989 from OBG-1 through OBG-6 and in July 1990 from OBG-7 through OBG-9. These represent two potentially different hydrologic scenarios. Therefore, any conclusions drawn from this data will be limited by this difference in sampling times.

A concentration map for Benzene and for total BETX compounds are shown on Figures 7 and 8, respectively. Since benzene is a chief constituent of these detectable compounds, the pattern of Benzene concentrations is similar to that of BETX concentrations. The highest BETX concentrations of several hundred thousand parts per million were found in OBG-1 and OBG-2. These concentrations are likely affected by the free phase floating on the water surface at these locations (see Table 5). Lower BETX concentrations of several thousand parts per billion were detected at OBG-6, downgradient from OBG 1 and OBG-2, and OBG-9. These concentrations at OBG-1, OBG-2 and OBG-6 and at OBG-9 likely represent separate impacts from gasoline and diesel or kerosene from the abandoned pipeline and underground gasoline tanks at OBG-1, OBG-2, and OBG-6 and from older gasoline leakage at the former pump island at OBG-9. Two separate areas of ground water contamination from solubilized aromatic compounds are exhibited on Figures 7 and 8.

It appears from these figures and available data that the solubilized plume of aromatic compounds around wells OBG-1, OBG-2, and OBG-6 is limited but elongate somewhat in a downgradient direction. Contamination from this plume

does not appear to have reached well OBG-8 located 150 feet from the existing underground gasoline storage tanks.

A second more dilute plume of aromatic constituents from an older gasoline spill is evident downgradient of the former fuel islands on the western part of the site. The extent and downgradient migration of this plume is currently not known.

SECTION 4 - RISK ASSESSMENT

4.04.01 - General

This section of the report reviews the site conditions to evaluate the actual and potential migration of the contaminants in the soil and ground water. The results of the analytical program are compared to established Federal and State regulatory standards or advisories. A health risk assessment of the contaminants in the ground water is presented to evaluate the potential health effect of not responding to the contamination on this site and the identification of contaminant transport scenarios which may contribute to human and environmental health risks.

4.02 - Actual and Potential Migration of Contaminants

As stated in the review of the hydrogeologic investigation in Section 3, the ground water contains two solubilized plumes containing BETX compounds. Due to the convergent pattern of ground water flow to the west along Tang Avenue, the exact downgradient migration of the plumes along Tang Avenue is not currently known. There is also the potential for the plume around the underground storage tanks to migrate into the subsurface drain system network which discharges at the outfall at Thames River. The potential health impact is discussed in Section 4.04 if migration of the contaminants were to reach the Thames River.

The concentration of aromatic hydrocarbons in ground water decreases significantly over short distances in some areas probably due to dilution and or attenuation to the soil matrix. There may also be some natural biodegradation occurring but no technical evidence is available to confirm this commonly occurring mechanism at the site. The potential migration of the aromatic plumes off the site cannot be accurately estimated from data developed to date.

4.03 - Contaminant Concentrations vs. National and Local Water Standards

According to the Base Public Works Department personnel, the ground water is classified as Class GB. The Connecticut Department of Environmental Protection (CTDEP) description of this classification is "Ground waters within highly urbanized areas or areas of intense industrial activity and where public water supply service is available. May not be suitable for direct human consumption due to waste discharges, spills or leaks of chemicals or land use impacts. The State's goal is to prevent further deterioration by preventing any additional discharges which would cause irreversible contamination."

According to preliminary discussions with CTDEP the policy is that for GB classified ground water, cleanup levels are site specific and would be determined on a case by case basis, which may consider background levels; however, the CTDEP may require cleanup to class GAA, drinking water standards. Class GAA ground water is subject to the standards of Section 19-13-B102 of the Connecticut Public Health Code, advisories of the Department of Health Services and primary and secondary standards of the Federal Safe Drinking Water Act.

The following table compares the highest levels of contaminants detected in the ground water with applicable Federal and State drinking water standards.

CONTAMINANT LEVEL VS. WATER STANDARDS

	HIGHEST	EPA (a)	CONN. DEPT.(b)
DETECTED	CONTAMINANT	MCL	OF HEALTH SERVICES
CONTAMINANT	LEVEL (ppb)	(ppb)	ACTION LEVEL (ppb)
Benzene	43,995	5 (F)	1
Ethyl Benzene	110,100	700 (P)	700*
Toluene	100,570	2000 (P)	1000
Xylene	52,260	10000 (P)	10000*

- (a) USEPA Maximum Contaminant Levels from "Drinking Water Standards and Health Advisory", April 5, 1989.
- (b) Action levels adopted by CTDEP.
- (F) Final Regulatory Status.
- (P) Proposed Regulatory Status.
- * Same as USEPA MCL.

As shown on Table 4, highest contaminant levels were all located at monitoring well OBG-1, except ethylbenzene which was highest at monitoring well OBG-2. In fact, benzene concentrations exceed the USEPA MCL of five ppb at wells OBG-1,2,4,6 and 9. The USEPA MCL and CTDEP action level of 700 ppb for ethyl benzene was exceeded in wells OBG-1, OBG-2, and OBG-9. The USEPA MCL of 2,000 ppb and CTDEP action level of 1,000 ppb for toluene was exceeded again in wells OBG-1, OBG-2, and OBG-9. The xylenes MCL and action level of 10,000 ppb was exceeded in wells OBG-1 and OBG-2.

In summary, applicable ground water standards were generally exceeded in wells OBG-1, OBG-2, and OBG-9 which represent the two separate plumes. Concentrations of benzene in wells OBG-4 and OBG-6 were also exceeded.

Although the USEPA promulgates MCLs, state regulatory agencies have the option to establish more stringent levels. Such is the case for benzene and toluene. If the CTDEP chooses to cleanup to class GAA ground water standards, the ground water remediation will have to be designed for the above action levels.

Also as discussed with the CTDEP Water Compliance Unit, the action levels for soil remediation are decided on a site specific basis. They occasionally use a 100 ppm total petroleum hydrocarbon (TPH) action level. Six (6) of the eight (8) soil borings analyzed for TPH have levels greater than 100 ppm.

4.04. QUALITATIVE RISK EVALUATION

4.04.01 General

This report presents a qualitative evaluation of the potential exposure risks associated with the Naval Exchange Gas Station at the Base in Groton, Connecticut ("the site"). The assessment addresses potential risks associated with chemicals detected in the air, soil, surface water, and ground water on, or originating from, the site. Consistent with the nature of a qualitative risk evaluation, the magnitude of potential exposures and the resultant risks are not quantified. The risk evaluation may be summarized as follows:

Of the four exposure pathways addressed (air, soil, surface water, and ground water), only the air pathway has the potential to facilitate exposures to chemicals of concern.

4.04.02 Site Location

The site is located on the southern end of the Base on a relatively flat terrace of the Thames River. The Thames River is located approximately 1,250 feet to the west of the site.

The site is currently operated as a gas station. Three underground storage tanks (USTs) are situated on the site; two 10,000-gallon steel tanks (containing Unleaded Supreme and Unleaded Plus gasoline), and one 15,000-gallon fiberglass tank (containing Regular Unleaded gasoline). Approximately 95% of the site is covered with asphalt, fuel islands, or buildings. One small grassy area (approximately 100 square feet) is present to the north of Island #1.

4.04.03 History of the Release

On October 10, 1989, gasoline was discovered in storm sewers adjacent to the site. Operations at the gas station were halted, and on October 11, 1989, the Connecticut Department of Environmental Protection (DEP) was notified of the release. The DEP stated that an investigation and cleanup were required to mitigate outfall of contaminants to the Thames River.

On October 11 and 12, 1989, the three gasoline USTs and pipelines beneath the facility were tested by C.P. Utilities. Leaks were detected at two locations in the piping system; all other pipes and tanks were determined to be tight based on hydrostatic testing (see Navy Memo dated 18 October, 1989, Appendix H).

- A significant leak was discovered in a crash valve located in the south dispenser pump on dispenser island #2 (which dispenses Unleaded Plus gasoline). When the crash valve was closed, gas was observed to leak at a rate of 2-4 ounces per minute. On October 11, the valve was replaced by Nutmeg Mechanical. The new valve was tested on October 12, and no leaks were detected.
- 2) A capped vertical pipe at dispenser island #1 (which dispenses Unleaded Supreme gasoline) was found to be leaking. On October 13, this cap was

replaced with a bleeder valve to allow air to be released from the system. The pipe was retested on October 13, and no leaks were detected.

On October 12, a baffle and weir were installed in Catch Basin #4 to collect gasoline floating on the water surface. Over a period of one week, gasoline was removed by a vacuum truck.

The gasoline noted in the catch basin system occurred at a time of low-flow ("dry weather") conditions (October 10, 1989). A period of heavy rainfall occurred immediately thereafter (one week later), at which time very little or no gasoline was noted in the catch basin system. Observations noted during a subsequent dry weather period (November 14, 1989) indicated only minor sheens and vapors in the affected catch basins. Based on these observations and the recent piping work at the facility, it appears that the gasoline release occurred over a relatively short period of time before it was noted. Station reconciliation records indicate no loss greater than 0.5% over the prior few months. Therefore, it was not possible to estimate the volume of lost product.

4.04.04 General Sampling Locations and Media

- Air samples were collected to evaluate the presence of chemicals of potential concern in site air.
- Ground water samples were collected from on-site monitoring wells to identify the presence of a contaminant plume in local ground water.
- Soil samples were collected during monitoring well installation to evaluate the horizontal and vertical distribution of chemicals of potential concern in site soil.
- Surface water samples were collected to evaluate the presence of chemicals of potential concern in stormwater runoff. Samples were collected from the on-site catch basin system and an outfall discharging to the Thames River.

4.04.05 Scope of the Risk Assessment

This assessment focuses on potential exposures to chemicals detected in the air, ground water, soil, and surface water at, or believed to be originating from, the site. The assessment is based on analytical results from sampling conducted by O'Brien & Gere Engineers, Inc. in November 1989 through June 1990, as well as recent site visits. The conclusions presented herein are limited to those which may be drawn from these data.

An exposure assessment is a tool which may be used to evaluate the potential health and environmental risks which may be associated with residual chemicals present at a site. There are a number of possible approaches to exposure assessment: exposures may be analyzed qualitatively to identify potential exposure scenarios, quantitatively to evaluate their magnitude and significance, or both. The exposure assessment presented herein is a qualitative assessment, conducted in accordance with guidelines and procedures of the United States Environmental Protection Agency (EPA) for evaluating human health risks related to hazardous waste sites, as described in the Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A) (EPA, 1989).

This exposure assessment is divided into two main sections:

- 1) Identification of chemicals of potential concern; and,
- 2) Exposure assessment.

4.04.06 Identification of Chemicals of Potential Concern

4.04.06.01 Environmental Sampling

Air - A complete description of the air sampling strategy and methodology is presented in Section 2.08. In summary, in January 1990, three air samples were collected at locations upwind, on-site, and downwind of the site. Air samples were collected over a period of 4.5 to eight hours.

Samples were analyzed for benzene, toluene, ethylbenzene, and xylenes (BETX) by gas chromatography.

Results of the air analyses are presented in Table 1 of Appendix H. In summary:

- ▶ Benzene was detected in the sample collected near the cashier's booth.
- ► Toluene was detected upwind of the site and on-site near the cashier's booth.
- Xylene was detected upwind of the site and on-site near the cashier's booth.
- ► Ethylbenzene was detected in the sample collected near the cashier's booth.

Based on analytical results, it appears that on-site concentrations of BETX are greater than upwind concentrations. However, since these chemicals were not detected in the downwind air sample, it appears that on-site concentrations are not being transported off-site, but are being diluted and dispersed at concentrations below detectable levels.

Ground Water - A complete description of the ground water sampling strategy is presented in Sections 2.07. In summary, in December 1989, six monitoring wells (OBG-1 to OBG-6) were installed on-site and sampled. Ground water samples were analyzed for volatile organic compounds (VOCs) by EPA Method 503 and Total Petroleum Hydrocarbons (TPH) by Infrared Spectroscopy (IR). Fuel oil fingerprint (FOFP) tests were conducted on two free-phased floating product samples collected from OBG-1 and OBG-2.

In June 1990, three additional monitoring wells (OBG-7 through OBG-9) were installed on-site and sampled. Samples were analyzed for VOCs by EPA Method 503 and TPH by IR.

Results of the ground water analyses are presented in Table 2 of Appendix H. In summary:

- VOCs were detected in six of the nine wells sampled;
- TPH were detected in three of the nine wells sampled; and,
- FOFP tests indicated the presence of gasoline in OBG-1 and OBG-2.

<u>Soil</u> - A complete description of the soil sampling strategy is presented in Section 2.04. In summary, in December 1989, five composite soil samples were collected during monitoring well installation. Soil samples were collected from various depth intervals, ranging from zero to 11 feet. Samples were analyzed for VOCs by EPA Methods 8010/8020, and TPH by IR. In addition, FOFP tests were conducted on three oil-saturated soil samples collected from OBG-1, OBG-4, and OBG-6.

In June 1990, three composite soil samples were collected during the installation of three additional monitoring wells (OBG-7 to OBG-9). Soil samples were collected from various depth intervals, ranging from four to nine feet. Samples were analyzed for VOCs by EPA Methods 8010/8020, and TPH by IR. In addition, a FOFP test was conducted on an oil-saturated soil sample collected from OBG-9.

Results of the soil analyses are presented in Table 3 of Appendix H. In summary:

- VOCs were detected in five of the eight soil samples collected;
- TPHs were detected in seven of the eight soil samples collected; and,

▶ FOFP tests indicate the following: the presence of gasoline in OBG-1 and OBG-9; gasoline, kerosene, fuel oil (#2, #4, and #6), and other petroleum contamination were not detected in OBG-4; and the presence of kerosene and diesel fuel in OBG-6.

Surface Water A complete description of the surface water sampling strategy is presented in Section 2.07. In summary, in November and December 1989, 10 water samples were collected from four catch basins (two inlets were sampled at CB-1: CB-1A and CB-1B). Samples were collected during dry weather conditions. Samples were analyzed for VOCs by EPA Method 503, and TPH by IR. In addition, a FOFP test was conducted on the water sample collected from CB-4.

In January 1990, one surface water sample was collected from an outfall to the Thames River, at a point approximately 1,250 feet downstream from the site. This outfall releases water collected by the on-site catch basin system. The sample was analyzed for VOCs by EPA Method 503, and TPH by IR.

Results of the surface water analyses are presented in Table 4 of Appendix H. In summary:

- ▶ VOCs were detected in three of the four catch basins sampled.
- ▶ TPHs were detected in three of the four catch basins samples.
- The FOFP test indicated the presence of gasoline, kerosene, and diesel fuel in CB-4.
- VOCs and TPHs were not detected in the sample collected from the outfall.

4.04.06.02 Summary of Chemicals of Potential Concern

The chemicals which were detected in the various environmental matrices are summarized in Table 5 of Appendix H. These chemicals were termed "chemicals of potential concern". As shown, 12 VOCs (including four volatile halogenated organics and 1 polynuclear aromatic hydrocarbon [naphthalene]) were identified.

4.04.06.03 Pertinent Toxicology of Chemicals of Concern

Appendix H presents relevant toxicology for the chemicals detected in the environmental samples. In general, the chemicals of potential concern are not highly toxic, and, given preliminary evaluation of complete exposure pathways, toxicity resulting from acute exposure is unlikely.

Chronic exposures to the chemicals of potential concern could result in a variety of systemic or carcinogenic effects. In general, following repeated exposures to high concentrations of these compounds, injury could occur to target organs (those organs which are sensitive to specific chemical damage), primarily the liver, kidneys, and central nervous system.

4.04.07 Exposure Assessment

Exposure is defined as the contact of an organism with a chemical or physical agent (e.g., chemicals of potential concern). Qualitative exposure assessment is the determination or estimation of the frequency, duration, and route of exposure. The qualitative exposure assessment proceeds with the following steps:

- ► Step 1 Characterization of exposure setting
- Step 2 Identification of exposure pathways

4.04.07.01 Characterization of Exposure Setting

The first step in evaluating exposure is to characterize the site with respect to its physical characteristics, as well as those of the human populations on and near the site. The output of this step is a qualitative evaluation of the site and surrounding populations with respect to those characteristics that influence exposure. Information gathered during this step supports the identification of exposure pathways in Section 4.04.07.02.

Physical Setting

Climate - The southeastern Connecticut region has a variable climate characterized by frequent but short periods of heavy precipitation. The region lies in the path of "prevailing westerlies" and of cyclonic disturbances that cross the country from the west or southwest towards the east or northeast. It is also exposed to occasional storms that travel up the Atlantic coast. Some storms are tropical and occasionally are of hurricane intensity. All storms in the region are heavily laden with moisture from the ocean. The maximum tide of record was in September 1938 when a hurricane generated surges 12 feet above normal high tide and caused severe damage to the region.

The average annual temperature is about 50° F. Average monthly temperatures vary widely throughout the year, from 58° to 72° F in July and August, to 23° to 30° F in January and February. Extremes in temperature range from the upper 90's to infrequent lows of 10° F or lower.

Annual precipitation has ranged from about 32 inches to 65 inches. About 22 inches are returned to the atmosphere each year by evaporation.

Geologic Setting - The site is located in an area which is underlain with meta-sediments and metaigneous layers which are characterized by the northeast-trending steeply dipping beds, and make up the leg of the overturn Quaker Hill Anticline. These rocks exhibit many episodes of minor folding and faulting as well as high grade and retrograde mineralogic assemblages.¹

<u>Vegetation</u> - The site is devoid of vegetation, with the exception of a small vegetated area approximately 50 feet to the north of Island #1. This grassy area is approximately 100 square feet in size. With the exception of a baseball field located across Tang Street, the vicinity of the site is highly-developed, industrial property with very limited vegetative cover.

Soil Type - The site is located in an area which formally contained a lake between two outcrops of rock to the northeast and southwest. The lake, which was historically known as "Crystal Lake", was reportedly dredged and filled in with upland soils to create a level surface for development of the Base. As a result, soils in the area contain an upper layer of fill which is variable in thickness and which overlies naturally occurring fine sand, silt, and organic silt of the former lake bed. On-site, the fill thickness varies from a few feet to approximately 15 feet, and is thicker around the USTs and stormwater drain pipes. The backfill used for these structures is probably of higher permeability than the fine-grained, natural soils surrounding it.

Fill material is comprised of three distinct units: 1) "dark brown, fine to medium sand/some fine gravel and silt", 2) "light gray-white, fine sand-silt", and 3) pea gravel (located around the tanks). Near the USTs, fill was

¹ Information was obtained from the Master Plan for the Naval Submarine Base New London.

observed at a depth of 16.5 feet. Away from the USTs, fill depths vary from four to seven feet. Monitoring Well OBG-6 revealed a fill depth of 10.5 feet, likely due to the UST located to the north. Natural material was seen as two distinct units: 1) "dark brown/black, fine silt/some fine sand/trace amounts of vegetation (roots, etc.)", and 2) "light gray, fine sand-CS-silt". The "dark brown/black" zone, viewed as an organic silt layer, is believed to represent lake bed, near shore, or swamp sediments. The earth material below this zone, "light gray, fine sand-CS-silt" is well sorted and believed to be glacial outwash deposit of the Pleistocene epoch.²

Ground Water Hydrology - Groundwater is present at a depth of nine feet below grade. Groundwater flow direction is to the south. To the south of the site, groundwater flow is northward toward the site. It is likely that groundwater also converges toward the site from the north, then continues westward the Thames River. Flow may be locally modified by more permeable trenches in the area.

The site is located on the east bank of the Thames River, about 6.5 miles upstream of the mouth. All surface drainage from the Base (including the site) is westward into the Thames River through an extensive stormwater collection system. There is no groundwater development on the Base since Groton Utilities provides all potable water from surface water supplies.³

² Information was obtained from a memo from Mark A. Randazzo (OBG) to NAVFAC-GROTON, CT dated December 28, 1989.

³ Information was obtained from the Master Plan for the Naval Submarine Base New London.

Location and Description of Surface Water

On-Site - Surface topography around the site ranges in elevation from 22 to 26 feet (USGS mean sea level datum) and decreases towards CB-1 on the southeastern portion of the site. Surface water runoff from paved portions of the site is directed toward the network of catch basins which traverse the site. A review of the storm drain blueprints indicates that the storm drain paralleling Tang Avenue flows easterly on the west side and westerly on the east side of the catch basin, converging at CB-3/4. The piping running north-south between CB-1 and CB-4 is below the water table.

Discharge from these basins is co-mingled with other surface drainage and blow-off from an oil condensing unit (at the tank farm across Tang Street) prior to outfall at a boomed outlet at the Thames River. The catch basins do not overflow, and water in the system is seven to ten feet below road level.

Off-Site - The Thames River flows approximately 1,250 feet to the west of the site. In this area, the River is an estuary. Marine invertebrate animals that are common in the Thames estuary include blue crabs, soft clams, hard clams, mussels, barnacles, scallops, annelids, amphipods, polychaestes, sea anemones, starfish, sponges, and lobsters.

Numerous resident and migrant fish species inhabit the Thames River estuary. A total of at least 61 species have been recorded, of which 57 use the Long Island Sound area as spawning grounds. The reach just south of the Base is known to be a nursery area for back flounder. Anadromous fish using the Thames River include sear run brown trout, American shad, rainbow smelt, white perch, striped bass, alewife, and glut herring.

An oyster and clam bed occurs in this reach of the Thames along its western bank opposite the Base. There are two major hard clam concentration areas located approximately two miles below the Base on either side of the river.⁴

Location of Current Populations Relative to the Site

On-site - The site is currently used as a gas station, serving regular and unleaded gasoline and providing car repair service to military personnel. Therefore, current on-site populations consist of on-site employees (cashiers and auto mechanics) and customers (buying gasoline and receiving automotive repair services).

Off-site - The site is located on the Base. Approximately 6,000 to 8,000 personnel live in barracks located approximately 1,000 feet to the east of the site. In addition, a baseball field is located across Tang Street to the south of the site.

Current Land Use

On-Site Receptors - The site is situated in an area which is zoned for commercial use. The site is currently used as a gas station, serving gasoline and offering automotive repair services. It is expected that the maximum daily exposure period for on-site employees is eight hours (an average work shift). It is expected that site employees remain indoors during an average work day; the cashier remains inside Building 428, and the mechanics remain inside the Bay.

⁴ Information was obtained from the Master Plan for the Naval Submarine Base New London.

The maximum daily exposure period for site customers is expected to be one hour. It is assumed that customers remain outdoors during their on-site activities (at the gasoline pump or waiting for their car to be serviced).

Due to the industrial/commercial nature of the site and its vicinity, the only type of wildlife which is expected to be present on-site is typical urban wildlife (e.g., birds).

Off-Site Receptors - Immediately to the north of the site is a parking lot. Approximately 2,500 feet to the north of the site is the Navy Exchange/commissary store.

To the south of the site is recreational land use and fuel storage. The surface of the land is used as a baseball field. Under the baseball field is an underground fuel storage area operated by the Base, where, historically, nine 750,000-gallon fuel storage tanks were located. Historically, Tanks #1, #2, #3, and #5 were used to store No. 6 fuel oil, while Tanks #4, #6, #7, #8, and #9 were used to store DFM. Currently, four tanks are in operation: Tanks #1, #2, and #3 contain No. 6 fuel oil, and Tank #5 contains waste oil. Currently, Tanks #4, #7, #8, and #9 are empty. Tank #6 was demolished over 15 years ago.

To the east and west of the site are various buildings. Most buildings are used for storage only. However, one building to the west of the site (Building 406) is a Public Works Department carpentry and grounds maintenance shop.

The following is a summary of sensitive populations within one mile of the site:

- ▶ children at the child care center (Building 521), located approximately one mile from the site;
- patients at Naval Hospital Groton, located approximately one mile from the site;
- no schools are present within one mile of the site; and,
- no retirement facilities are present within one mile of the site.

Future Land Use

According to the Master Plan for the Base, the Base is a highly-developed, industrial property. Therefore, it was assumed that future land uses on-site and in its vicinity will remain the same as present.

4.04.07.02 Identification of Exposure Pathways

An exposure pathway describes the course a chemical takes from the source to the exposed individual. An exposure pathway analysis links the sources, locations, and types of environmental releases with population locations and activity patterns to determine the significant pathways of human exposure.

An exposure pathway generally consists of four elements:

- 1) a source and mechanism of chemical release;
- 2) a retention or transport medium;
- a point of potential human contact with the contaminated medium (referred to as the exposure point); and,
- 4) an exposure route (e.g., ingestion) at the contact point.

Possible release sources, release mechanisms, and receiving media were identified for past, current, and future release (see Table 6 of Appendix H). As shown, it was determined that air, surface water, ground water, and soil are/were potential receiving media for release sources.

The fate and transport of the chemicals of potential concern were evaluated to help link sources with currently contaminated media. To determine the fate of the chemicals, information was obtained on their physical/chemical and environmental fate properties. The information is presented in Table 7 of Appendix H.

Potential exposure points were identified by determining if and where any of the potentially exposed populations (identified in Section 4.04.07.01) can contact the receiving media presented in Table 6 of Appendix H. Any point of potential contact with a contaminated medium was considered to be a potential exposure point (see Table 8 of Appendix H). In general, potential exposure points were identified where the concentration that could be contacted is the greatest.

After determining potential exposure points, potential exposure routes were identified based on the media contaminated and the anticipated activities at the exposure points. Potential exposure routes are presented in Table 9 of Appendix H.

Following the identification of potential exposure points and potential exposure routes, complete exposure pathways were identified (see Table 9 of Appendix H). A pathway was considered to be complete if there is:

- 1) a source or chemical release from a source;
- 2) an exposure point where contact can occur; and
- 3) an exposure route by which contact can occur.

If these conditions are not met, the pathway was determined to be incomplete. The following conclusions were made:

Air Pathway

On-Site - For current conditions, the air exposure pathway via inhalation was determined to be complete for on-site receptors. Chemicals of potential concern (BETX) were detected in the air sample collected on-site near the cashier's booth. However, since the site is an active gas station, it is likely that the atmospheric concentrations are a result of volatilization of gasoline constituents during dispensing, rather than volatilization from the historic gasoline spill.

For future conditions, the air exposure pathway via inhalation was determined to remain complete at on-site locations. Due to the use of the site as a gas station, it is expected that chemicals of potential concern will continue to be released to the atmosphere via volatilization.

Due to the low concentrations of BETX detected in the air samples (see Table 1 of Appenedix H), the magnitude of potential inhalation exposures is expected to be low.

Off-Site - For current and future conditions, the air exposure pathway via inhalation was determined to be incomplete for off-site receptors. As shown in Table 1 of Appendix H, chemicals of potential concern were not detected in air samples collected from the location downwind of the site.

Surface Water Pathway

On-Site - For current and future conditions, the surface water exposure pathway via incidental ingestion and dermal absorption was determined to be incomplete for on-site receptors. Although VOCs were detected in the water samples collected from the catchbasin system, water in the catchbasin

system is inaccessible (approximately seven feet below ground surface), and the catchbasin system does not overflow during storm events.

Off-Site - For current and future conditions, the surface water exposure pathway via incidental ingestion and dermal absorption was determined to be incomplete for off-site receptors. Water in the catchbasin system flows off-site and is discharged to the Thames River via an outfall. Water in the catchbasin system is inaccessible, and chemicals of potential concern were not detected in the sample collected from the outfall at the Thames River.

Ground Water Pathway - For current and future conditions for receptors at on-site and off-site locations, the ground water exposure pathway via ingestion, dermal absorption, and inhalation was determined to be incomplete. Although ground water analyses indicate the presence of chemicals of potential concern in on-site ground water, ground water users are not present on-site or in its vicinity.

The site and its vicinity are serviced with municipal water from Groton Utilities, which receives its water from the Groton Reservoir.

Soil Pathway

On-Site - For current and future conditions, the soil exposure pathway via incidental ingestion and dermal absorption was determined to be incomplete at on-site locations. Although soil analyses indicate the presence of chemicals of potential concern in the top 1.5 feet of soils at the site, contaminated soil is inaccessible (below blacktop or buildings), and is expected to remain so.

Off-Site - For current and future conditions, the soil exposure pathway via incidental ingestion and dermal absorption was determined to be incomplete at off-site locations. As previously stated, the contaminated soil on-site is inaccessible; therefore, it is expected that off-site tracking and fugitive dust emissions have not transported contaminated soil to off-site locations. In addition, although the ground water contaminant plume extends beyond the site's southern boundary, the soil in this area is under Tang Street, and therefore inaccessible.

4.04.08 Summary

The objective of the risk assessment was to qualitatively analyze potential exposures at the Naval Exchange Gas Station Site, under present and future (no action) site conditions. Each exposure pathway was evaluated for its completeness. Complete pathways were identified on the basis of 1) a potential receptor population and 2) a potential exposure and uptake mechanism. In summary:

On-Site - For current and future site conditions, the air exposure pathway was considered to be complete at on-site locations. This conclusion was based on the detection of BETX in air samples collected on-site. Since the site is an active gas station, it is likely that the atmospheric concentrations are a result of volatilization of product during dispensing, rather than volatilization from the historic fuel spill.

Off-Site - For current and future site conditions, the four exposure pathways (air, surface water, ground water, and soil) were considered to be incomplete at off-site locations, based on the following:

► Air - Chemicals of potential concern were not detected at the site boundary;

- Surface Water Water in the catchbasin system is inaccessible, and chemicals of potential concern were not detected at the outfall to the Thames River;
- Ground water There are no ground water users in the vicinity of the site; and,
- ► Soil Contaminated soil is inaccessible.

SECTION 5 - PRELIMINARY EVALUATION OF REMEDIAL ALTERNATIVES

5.01 - General

This section of the report evaluates the feasibility of free product recovery and recycle and represents and evaluation of the adequacy of collected data. Also, alternative remedial methods are identified and evaluated in terms of construction, feasibility, effectiveness, efficiency, and cost.

5.02 - Product Recovery

Free product, consisting of dark colored, non-viscous, weathered gasoline was noted in wells OBG-1 and OBG-2. The apparent product thickness, as shown in photographs included in Appendix I, ranged from 1/8 inch to three inches in the wells based on several measurements and averaged about 2 inches. By using an average apparent free product thickness of two inches and an estimated free product pool area of 1,700 square feet from Figure 5B, the estimated volume of recoverable free product was calculated as shown:

The apparent product thickness of 0.17 feet was first divided by four to estimate the true thickness of product in the aquifer (Concawe, 1979) which equals 0.04. This value was then multiplied by 1,700 square feet which totalled 68 cubic feet times 7.5 gallons per cubic feet which equals 510 gallons. This figure was multiplied by a bulk porosity estimate of 0.35 for gravel (Freeze and Cherry, 1979, p.37) which totalled about 180 gallons of free phase product in the aquifer. Literature suggests that about 85% of product contained in a typical sandy soil which is 100% saturated (light weight fuels gasoline or diesel), may be recoverable. Thus 15% would remain residually saturated in the soil matrix without flushing. This calculates to about 150 gallons of recoverable product.

Free phase product and contaminated ground water should be recovered. The free phase product should be recovered as an interim measure and contaminated ground water recovery and treatment should be implemented as part of the longer term remediation plan.

Passive Product Recovery

A passive recovery system should be installed as an interim or short term measure for product reovery. The passive system is designed to recover the free phase petroleum product layer by skimming the water surface but not depressing the water table. A portable unit, the Auto-Skimmer by R.E. Wright Assoc., can be installed in the present 2" ID monitoring wells, OBG-1 and OBG-2. This system may remove a substantial amount of free phase product from wells OBG-1 and OBG-2 due to the height of the product present in these wells and the lack of drawdown shown in these wells during previous sampling operations at the site.

The system contains one 15 gallon oil/water separator and includes two float switches that can be inserted into two separate 55 gallon drums used for oil and ground water collection. When the water level or oil level in either 55 gallon drum contacts either float switch, the Auto-Skimmer shuts off.

\$1,200/mo.

Additional information describing the unit is included in Appendix I.

Costs for the Auto-Skimmer include:

Rental Cost of Auto-Skimmer for 1st Month	\$2,000/mo.
(including start-up)	

·*	
Rental Cost of Winter Blanket	\$1.400/mo.

Rental Cost of Winter Blanket	\$1,400/mo.
(prevents water handling parts from freezing)	

Other Equipment	•	\$1,200
(55 gallon drums,	forklift for unloading)	

Subsequent Months

Freight transportation to Groton, Connecticut (round-trip)\$ 500 Unit Decontamination (upon return to vendor) \$ 200

Total cost for the Auto-Skimmer is approximately \$5,250 plus \$2,600 for each additional month of use.

5.03 - Evaluation of Collected Data

Results of this study indicate that two areas of contamination by petroleum hydrocarbon residues were delineated within the boundaries of the Naval Exchange station. These areas consist of: 1) A non-aqueous phase gasoline product layer on the ground water table around the three existing USTs, with an associated plume of solubilized aromatic petroleum hydrocarbons (BETX) immersed in the ground water beneath it, and 2) A separate plume of solubilized BETX in the ground water near the former pump islands and USTs on the western part of the site.

The sources of the contamination in area No.1 is believed to have resulted from gasoline releases at: the crash valve, leakage from former USTs that have since been replaced, small scale spills from pumping at the fuel islands, and leakage of diesel or kerosene from an abandoned underground pipeline near fuel island No. 1. The exact source of contamination in area No.2 is less certain because the fuel islands and USTs have been abandoned or replaced and covered over with no associated documentation currently available. Leakage from these structures probably contributed to the plume in this area.

The delineation of the free phase product layer and solubilized plume in area No.1 has been adequately characterized as shown on Figures 5A, 5B, 7, and 8. The recoverable product volume was estimated to be 150 gallons. The plume of solubilized BETX compounds in ground water around this product is considered to be adequately characterized in the upper aquifer within the station boundary to Tang Avenue. A degree of uncertainty remains

regarding the downgradient extent of the plume along Tang Avenue because no wells exist along the street.

No detectable BETX concentrations were found, however, at well OBG-8 in a downgradient direction. By extrapolating the exponential decrease shown by contours on the property, it can be reasonable to assume that the downgradient extent of the plume is similar to that shown on Figures 7 and 8.

With regard to the adequacy of plume characterization at the former fuel islands near well OBG-9, the concentrations identified (particularly benzene at 1,000 ppb) indicate that additional delineation of this plume is warranted. It is recommended that a soil vapor survey be conducted on this part of the site to develop a qualitative estimate of the extent of contamination. The soil vapor survey could also extend to the downgradient extent of plume No.1 to further evaluate that plume.

It is also recommended that eventually two similar monitoring wells be installed at the fuel island and tank locations to evaluate potential free phase product and dissolved phase constituents at this "source area". It is also recommended that approximately two additional downgradient wells be placed to further characterize the downgradient extent. The exact amount of wells needed may change based on the soil vapor study and findings from each well.

It is our understanding that the recommendation for additional field investigations at the former fuel islands will be addressed by the Naval Facilities Engineering Command as a separate project. For the purpose of selecting the remedial alternatives outlined in this report, sufficient data has been produced from field investigations completed to date.

5.04 Screening of Remedial Alternatives

Several potential remedial alternatives identified were compared to categories of remedial technologies to determine which alternative was applicable as follows:

Site Problem

Remedial Technology Category

Ground Water Contamination

- In Situ Treatment

- Ground Water Recovery and Treatment
- Waste and Soil Excavation and Disposal

Soil Contamination

- In-Situ Treatment

- Direct Waste Treatment
- Waste and Soil Excavation and Disposal

Remedial technologies within each category were then eliminated on the basis that they may prove difficult to implement, rely on unproven or inapplicable technologies, or may not achieve the remedial objectives within a reasonable time period. The effectiveness of the identified alternatives were evaluated based on the ability to:

- 1. Comply with the applicable or relevant and appropriate requirements to other federal environmental statutes.
- 2. Short-term effectiveness.
- 3. Long-term effectiveness.
- 4. Protect human health and the environment.
- 5. Significantly or permanently reduce the toxicity, mobility, or volume of hazardous constituents.
- 6. Implementability factors.
- 7. State acceptance.
- 8. Community acceptance.

9. Cost factors (present worth).

The above nine (9) criteria were used to screen the selected remedial alternatives and to determine the most appropriate alternatives for further consideration.

5.04.01 Screening of Remedial Alternatives for Ground Water Contamination

After review of potential methods from the selected general remedial technology categories, the following technologies were determined feasible for the site conditions:

- 1. No action.
- 2. Air stripping with off-gas treatment.

A summary of some of the technologies eliminated and the criteria that failed are as follows:

- 1. Biodegradation The CTDEP water quality standard of 1 ppb benzene can not be met with biodegradation. Also, in order to effectively utilize the biodegradation technique, a bench-scale study of on-site ground water would have to be completed. Therefore, due to technical constraints biodegradation was not considered further.
- 2. Granular Activated Carbon (GAC) The carbon adsorption technology has a 99% or more efficiency for capture of hydrocarbon contamination water. However, in order to achieve that efficiency with the concentrations of BETX present in the ground water, exorbitant quantities of GAC would be necessary. This would increase the overall cost of the GAC method to the point that the GAC method would not be economically feasible in comparison with other techniques.
- 3. Off-Site Disposal Ground water would be pumped directly from the recovery wells to the Town of Groton Sewer Treatment Plant. However, this off-site disposal method is not an option because the Town of Groton's plant is unable to treat water with any level of hydrocarbons.

5.04.02 Screening of Remedial Alternatives for Soil Contamination

After review of potentially applicable methods from the selected general remedial technology categories, the following technologies were feasible for the site conditions:

- 1. No action.
- 2. Vacuum extraction with off-gas treatment.

A summary of the technologies eliminated and the criteria that the elimination was based on are as follows:

- 1. In-situ Biodegradation Biodegradation would be performed on approximately two (2) feet of aerated soil. However, approximately nine (9) feet of contaminated soil exists at the Groton site. Thus, remediated soil would have to be excavated and stockpiled until biodegradation of all the soil was completed. Also, bench scale studies of the process would have to be performed. Due to the experimental nature of the process and the increased costs and site exposure, the biodegradation process will not be considered further.
- 2. Excavation With Off-Site Disposal Off-Site disposal is not feasible because the TCLP characteristic of benzene in the soil would exceed the acceptance limit, as set by Federal Regulations, for disposal.
- 3. Excavation with Off-Site Treatment Contaminated soil would be excavated from the site then sent to a hot-mix asphalt (HMA) facility. Off-site treatment is a feasible, permanent solution as the future liability for the waste would be relieved from the U.S. Navy. However, the excavation process would severely impair the activity at the service station, thus rendering this alternative unacceptable.
- 4. Excavation with On-Site Treatment This alternative is similar to option No. 3, except that a cold emulsification process is performed on-site. Again, the excavation necessary to utilize this technique would severely impact station operations.

5. Chemical Treatment - The chemical treatment alternative is excessively expensive and the residual chemical used to treat the soil may cause additional contamination. Therefore, the chemical treatment alternative was eliminated from further review.

5.05 Development of Remedial Alternatives

Feasible remedial alternatives which were identified during the screening process were then considered for development as remedial options.

5.05.01 Development of Remedial Alternatives for Ground Water Contamination

Prior to developing the remedial alternatives, it was necessary to determine the most practical way to recover the contaminated ground water. The method available which can be applied to the site conditions is the installation of recovery wells.

The goal of modelling RW-1 was to develop a well that would initially function as a product recovery well and could then be used to recover contaminated ground water around the tank fill area. Using the Theis based ground water flow model, this well was simulated for 90 days at 10 gpm using gravel coefficients previously discussed. The resultant drawdown in the pump well was estimated to be only about 0.2 feet and 0.1 feet at a distance of 100 feet. It is recognized however that this gravel layer is discontinuous and the gravel layer would be essentially dewatered in less than two days at this flow rate. The transmissivity of the surrounding soils would then control the drawdown around the tank fill area and the yield of the well. Therefore the tank trench (about 10 ft. radius estimate) was modelled as a large diameter well to determine the hydraulic effects on the surrounding natural aquifer of much lower transmissivity once the fill was dewatered.

The result of this effort indicated that once the ground water in the tank fill was drawn down to the base of the fill at a depth of 17 feet, a flow rate of only one to 2 gpm

would be required to maintain that pumping level. By doing this, the free phase product can be captured initially and while the ground water is depressed to the base of the fill, this would create a sufficient cone of influence in the surrounding aquifer to capture that contaminated ground water. The model results indicate that ground water in the natural soils just outside of the tank area would be depressed about eight feet. The ground water would be depressed about 0.8 feet at a distance of 100 feet.

Pump controls in this well should be set at a depth of 18 feet (off-control) and 16 feet (on-control). The pump should be set at a depth of 21 feet and rated at a capacity to pump of 21 feet and rated at a capacity to pump from 0.5 to 10 gpm at a pumping head of 22 feet. A product scavenger probe should be set in the control separation.

With regard to recovery well No. 2, this well location was chosen to capture the downgradient portion of the plume. Aquifer coefficients used for this well were similar to the large diameter simulation for RW-1. Based on this effort, it was found that this well should be set at a depth of 30 feet and screened with 20 feet of No. 010 slot stainless steel screen and suitable gravel pack. The estimated static depth to ground water in this well is 10 feet below grade providing 20 feet of saturated aquifer thickness. Using a hydraulic conductivity of 2.6 gpd/ft² (Section 3.03), an aquifer thickness of 20 feet, a storage coefficient of 0.2 for sandy silt (Cleary R., Groundwater Poll. and Hydrogeology) and a transmissivity of 52 gpd/ft.

The drawdown in the pumping well at a time of 90 days and a rate of 0.5 gpm would be 17 feet. The drawdown at 100 feet away would be 0.35 feet. This cone of influence would be sufficient to capture this portion of the contaminant plume.

For the purpose of developing the number of recovery wells necessary to capture the floating product and solubilized BETX plume, simulations were made by use of a two-

dimensional analytical ground water flow model based on the Theis non-steady state equation with Jacob's correction for unconfined conditions.

The model assumes uniform hydrogeologic conditions, a flat hydraulic gradient, and no additions or subtractions of ground water to the system. The geologic conditions beneath the site are not uniform i.e. gravel fill layers, lacustrone silt deposits, etc. Water is also added to the system by percolation of precipitation and removed by infiltration into subsurface drains resulting in a complex system. As a result, the ground water model was used only as a guide to develop the amount, specifications, and positioning of the amount of recovery wells which were considered sufficient to accomplish the goal of the recovery program. It should be recognized that this effort represents anticipated pumping response from somewhat generalized conditions. Localized flow conditions may result which are different from the results predicted herein. Individual hydrologic units were modelled separately in each well based on their different characteristics and were then integrated into the recommended recovery system based on professional experience.

The backfill around the 15,000 gallon UST is highly permeable and contains free phase product floating on the ground water surface. The remainder of the site contains miscellaneous artificial fill deposited on natural silt layers. The extent of free phase product in the gravel layer is shown on Figure 5B. The conceptual goal of the recovery system is to remove floating product in this area and to capture the solubilized BETX plume around it and in a downgradient direction up to Tang Avenue.

Two recovery wells (RW-1 and RW-2) were modelled with locations shown on Figure 9. Recovery well No. 1 was placed on the northeast side of the 15,000 gallon UST where product was found and was suspected of entering the subsurface drain line between catch basins CB-7 and CB-1. This location is also not in the path of vehicular traffic. The hydraulic conductivity and transmissivity of the gravel layer were estimated

to be 12,000 gpd/ft² and 84,000 gpd/ft respectively based on values presented in Section 3.03 and a saturated thickness of seven feet. The well design for RW-1 consisted of an eight-inch diameter stainless steel screen set from a depth of 22 feet up to five feet connected to a low carbon steel riser to ground surface. It is recommended that the lower five feet of the well screen consist of No. 0.010 slot with a suitable gravel pack (silt layer) connected to 12 feet of No. 0.060 slot screen naturally developed in the existing gravel layer around the tank.

The pump in RW-2 should be set at a depth of 29 feet and the off-control should be set at 26 feet and on-control at 24 feet. The pump should be rated to provide 0.5 to 10 gpm at pumping head of 30 feet. It is not anticipated that product will be recovered in this well.

It is recommended that a monitoring program be initiated at the start-up of the system and be continued for a sufficient period of time until the system approaches steady state conditions.

From the screening of remedial alternatives for ground water contamination, the following remedial alternatives were developed:

- 1. No action.
- 2. Air stripping with off-gas treatment.

Alternative No. 1 - No Action

As explained in Section 4.04.07.02 of this report, "For current and future conditions for receptors at on-site and off-site locations, the ground water exposure pathway via ingestion, dermal absorption, and inhalation was determined to be incomplete." (A pathway is considered incomplete if there is no source or chemical release from a source; no exposure point exists where contact can occur; and no exposure route exists by which contact can occur.) Therefore, per the results of the risk assessment, the existing ground water

conditions do not pose any potential future risk. If the Navy could obtain appropriate approval from the CTDEP, no action would have to be taken to remediate the ground water at the Groton site.

Alternative No. 2 - Air Stripping with Off-Gas Treatment

The air stripping method removes volatile organics and volatile hydrocarbons from water. Air strippers can be retrofitted in the field to provide equipment that will meet treatment needs. One major concern of the air stripping method is the emissions from the off-gas to the atmosphere. The treatment of this gas would be determined according to CTDEP specifications. Granular activated carbon would most likely be utilized to treat the off-gas because of its efficiency and long-term effectiveness.

The following is the estimated costs for an air stripper with a flow rate of 4 gpm.

Assumption: Two wells at a total of 4 gpm. Discharge of treated water to the Navy's existing oil/water separator, approximately 1,000 feet from the site. Costs for conveyance to the oil/water separator has not been considered in this estimate.

Capital Costs	<u>GAC</u>
Air Stripper	\$20,000
Off-Gas Treatment	\$10,000
Well Installation	13,000
Total Capital Costs	\$43,000

Annual Operating Costs:

Maintenance (per year)	\$10,000
Sampling (per year)	_5,000

Total Annual Costs \$15,000

First Year Costs \$56,865

Present Worth - 5 Years \$99,865 (at 10% interest rate)

The length of time the system would have to operate will be evaluated following the recommended pump test.

5.05.02 Development of Remedial Alternatives for Soil Contamination

Feasible remedial alternatives which were identified during the screening process were then considered for the development of remedial options.

From the screening of remedial alternatives for soil contamination, the following remedial alternatives were developed:

- 1. No action.
- 2. Vacuum extraction with off-gas treatment.

Alternative No. 1 - No Action

As stated in Section 4.04.07.02 of this report, "For current and future conditions, the soil exposure pathway via incidental ingestion and dermal absorption was determined to be incomplete at on-site locations. Although soil analyses indicate the presence of chemicals of potential concern in the top 1.5 feet of soils at the site, contaminated soil is inaccessible (below blacktop or buildings), and is expected to remain so.

For current and future conditions, the soil exposure pathway via incidental ingestion and dermal absorption was determined to be incomplete at off-site locations. As previously stated, the contaminated soil on-site is inaccessible; therefore, it is expected

that off-site tracking and fugitive dust emissions have not transported contaminated soil to off-site locations. In addition, although the ground water contaminant plume extends beyond the site's southern boundary, the soil in this area is under Tank Street, and therefore inaccessible."

Therefore, per the results of the Risk Assessment, the existing soil conditions do not pose any potential future risk. If the Navy could obtain appropriate approval from the CTDEP, no action would have to be taken to remediate the soil at the Groton site.

Alternative No. 2 - Vacuum Extraction with Off-Gas Treatment

A vacuum extraction system could be installed to strip volatile materials from the soil in place. Vacuum extraction systems consist of an array of well screens installed within unsaturated soils that are connected through a piping system to the suction of a blower unit. The blower unit will discharge to a rechargeable carbon adsorption unit to control air emissions. Carbon will be regenerated off-site.

The system will be operated for approximately one year. These costs represent one year of operation.

Capital Costs

Vacuum Extraction Unit	\$ 98,000
(includes operation, maintenance and	mobilization/demobilization)
Off-Gas Treatment	\$ 10,000
Well Installation	<u>\$ 13,000</u>
Total Capital Costs	\$126,000
Other Costs:	

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Sampling After Remediation (one year)

Total Other Costs

Total Costs

\$ 5,000

\$ 5,000

\$131,000

SECTION 6 - SUMMARY AND RECOMMENDATIONS

6.01 - Summary

Field investigations were performed in accordance with O'Brien & Gere's "Plan of Action" for the Naval Exchange Gas Station dated November 1989. Figures 6-8 of this report delineate the BETX and TPH contaminated soil, surface water, and ground water areas located during the field investigations. Also, Tables 1 through 5 summarize the results of the analyses performed on the samples collected during the field investigation.

A Health and Safety Plan was prepared by a certified Industrial Hygienist prior to initiating field work. The plan presented site specific health and safety provisions to be instituted during field work.

The results of the field investigation have enabled O'Brien & Gere to summarize the most recent scenario of contaminant impacts on-site and to prepare a Risk Assessment for the site.

Where appropriate, data generated for this study was used to develop a conceptual remedial approach and to assess the needs for additional information necessary for the completion of final design specifications for the selected remedial alternatives.

Potential soil and ground water remediation methods were screened and economically and technically feasible remedial alternatives were then developed to establish present worth costs for remediation.

Feasible remedial alternatives for ground water contamination and the respective present worth costs are as follows:

- 1. No action no cost.
- 2. Air stripping with off-gas treatment \$99,865 (5 years).

The most effective method for recovering ground water for treatment is the installation of (2) two recovery wells. The cost for the recovery well system, including the pumping system, is approximately \$13,000.

Feasible remedial alternatives for soil contamination are as follows:

- 1. No action no cost.
- 2. Vacuum extraction with/off-gas treatment \$131,000 (one year of operation).

6.02 - Recommendations

This report should be submitted to the CTDEP and a "No Action" alternative should be sought for the soil and ground water contamination. Product recovery at the site should be pursued utilizing the short-term passive method as described in this report. It is anticipated that 85% of the product could be removed in the manner described herein.

Tables



TABLE I

NAVAL EXCHANGE GAS STATION

UNDERGROUND STORAGE TANK SPILL INVESTIGATION AND REMEDIAL DESIGN
SUBMARINE BASE NEW LONDON
GROTON, CONNECTICUT

GROUND WATER ELEVATION DATA

		Ground	Casing				Ground V		ion (Ft)	
Well No.	Well Depth (Ft)	Elev. (Ft)	Elev. (Ft.)	Screened		Interval (Ft)	12/15/89	12/18/89	1/08/90	07/30/90
OBG-1	14.00	100.03	99.84	86.03	_	96.03	90.84	90.58	90,74	90.72
OBG-2	17.00	100.13	99.66	83.13		93.13	90.66	90.59	90.72	90.44
OBG-3	17.00	100.09	99.90	83.09	-	93.09	90.46	90.36	90.38	90.52
OBG-4	16.00	99.97	99.75	83.97	-	93.97	90.93	90.87	90.89	90.80
OBG-5	18.00	99.96	99.71	81.96	-	91.96	90.84	90.81	90.78	90.80
OBG-6	17.00	99.60	99.09	82.60	-	92.60	90.65	90.67	90.39	90.37
OBG-7	15.00	99.47	99.25	84.25	-	94.25				91.52
OBG-8	15.00	98.92	98.73	83.73	-	93.73				91.27
OBG-9	15.00	99.61	99.49	84.49		94.49				91.46
CB-1 CB-7 CB-5**	100.00 99.07 94.00		89.95 92.22 88.00			***************************************				·

^{*} Elevations based relative to an on-site datum, not mean sea level.

^{**} Approximate

TABLE 2 SUMMARY OF CATCH BASIN SURFACE WATER ANALYSES

NAVFAC - SUBASE NEW LONDON GROTON, CONNECTICUT

CATCH BASIN	SAMPLING DATE	BENZENE PPB	TOLUENE PPB	TOTAL XYLENE (PPB	ETYL- BENZENE (PPB)	TPH (PPM)
CB-1A	11/14/89	17	18	2	ND	ND
	12/15/89	40	41	6	1	19.2
CB-1B	11/14/89	4850	3680	850	ND	3.2
	12/15/89	800	661	187	308	21.8
CB-4	11/14/89	20	ND	3	ND	ND
	12/15/89	107	99	18	2	4.9
CB-5	11/14/89	52	16	18	ND	ND
	12/15/89	95	99	19	4	ND
CB-7	11/14/89	ND	ND	ND	ND	ND
	12/15/89	ND	ND	ND	ND	8

NOTES:

TPH - Total Petroleum Hydrocarbon ND - Not Detected

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TABLE 3 SUMMARY OF SOIL BORING LABORATORY ANALYSES **NAVFAC - SUBASE NEW LONDON** GROTON, CONNECTICUT

SOIL BORING #	DEPTH (FT)	BENZENE (PPB)	TOLUENE (PPB)	TOTAL XYLENE <u>(PPB)</u>	ETHYL- BENZENE (PPB)	ТРН <u>(РРМ)</u>	FINGERPRINTED * CONTAMINANT
OBG-1 (composite)	0-3, 3-5	3	7	35	35	163	NA
OBG-1	7-9	NA	NA	NA	NA	NA	Gasoline
OBG-2	9-11	32270	71235	147100	39705	2240	NA
OBG-3	Tip readings	were negative; r	o soil samples	were submitte	ed.		
OBG-4 (composite)	0-3, 3.5-5.5	ND	ND	ND	ND	52.2	NA
OBG-4	5.5-7.5	NA	NA	NA	NA	NA	ND
OBG-5	7-9	310	200	950	40	11400	NA
OBG-6	7-9	280	13191	810	60	3900	NA
OBG-6	9-11	NA	NA	NA	NA	NA	Kerosene, Diesel Oil
OBG-7	7-9	ND	ND	ND	ND	526	
OBG-8	6.5-8.5	ND	ND	ND	ND	106	
OBG-9 NOTES:	4-6	1500	1500	2500	500	ND	Gasoline

ND - Not Detected

NA - Not Analyzed for

TPH - Total Petroleum Hydrocaerbon

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^{* -} Fuel oil fingerprint analyses for Gasoline, Kerosene, #2 Fuel Oil, #4 Fuel Oil, #6 Fuel Oil and Diesel Fuel presence.

TABLE 4

SUMMARY OF GROUND WATER ANALYSES NAVFAC-SUBASE NEW LONDON GROTON, CONNECTICUT

			TOTAL	ETHYL-	TOTAL	
MONITOR	BENZENE	TOLUENE	XYLENE	BENZENE	BETX	TPH
WELL #	(PPB)	(PPB)	(PPB)	(PPB)	(PPB)	(PPM)
OBG-1	43995	100570	52260	22420	219,245	5090
OBG-2	32080	33580	25200	110100	200,960	625
OBG-3	ND	ND	ND	ND	ND	ND
OBG-4	21	6	1.7	ND	28.7	ND
OBG-5	ND	ND	ND	ND	ND	ND
OBG-6	1210	250	680	400	2,540	288
OBG-7	ND	3	ND	ND	3	ND
OBG-8	ND	ND	ND	ND	ND	ND
OBG-9	1000	4000	3800	1300	10,100	ND

NOTES:

TPH - Total Petroleum Hydrocarbon ND - Not Detected

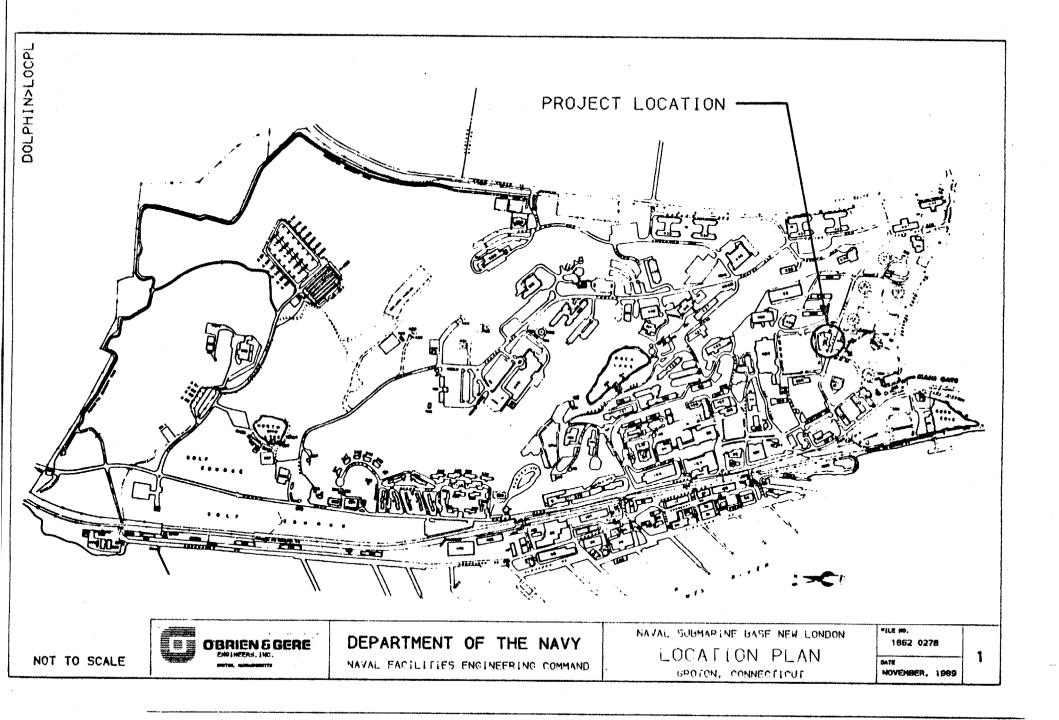
TABLE 5 SUMMARY OF FREE PHASE LABORATORY DATA

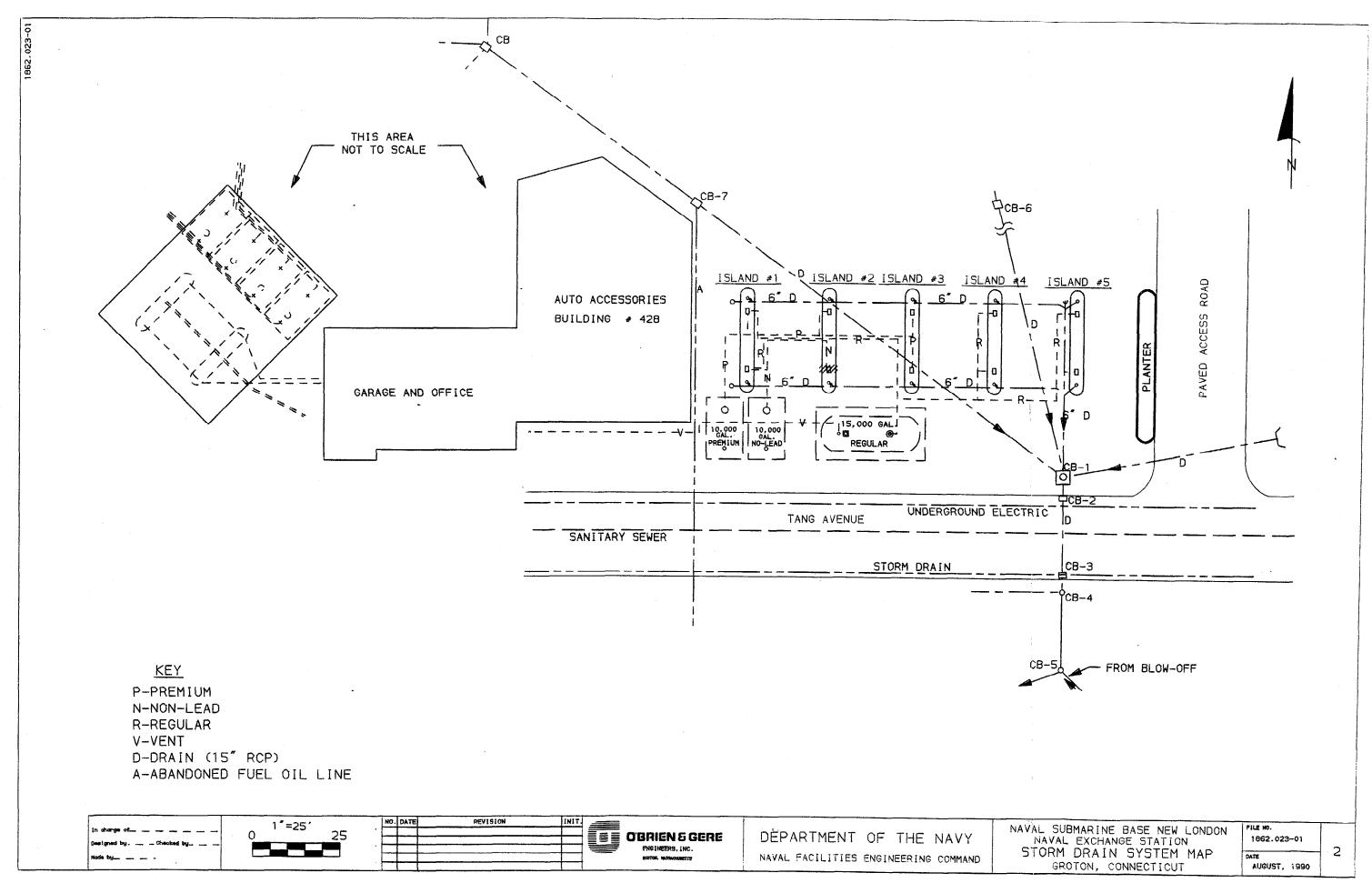
NAVFAC - SUBASE NEW LONDON GROTON,

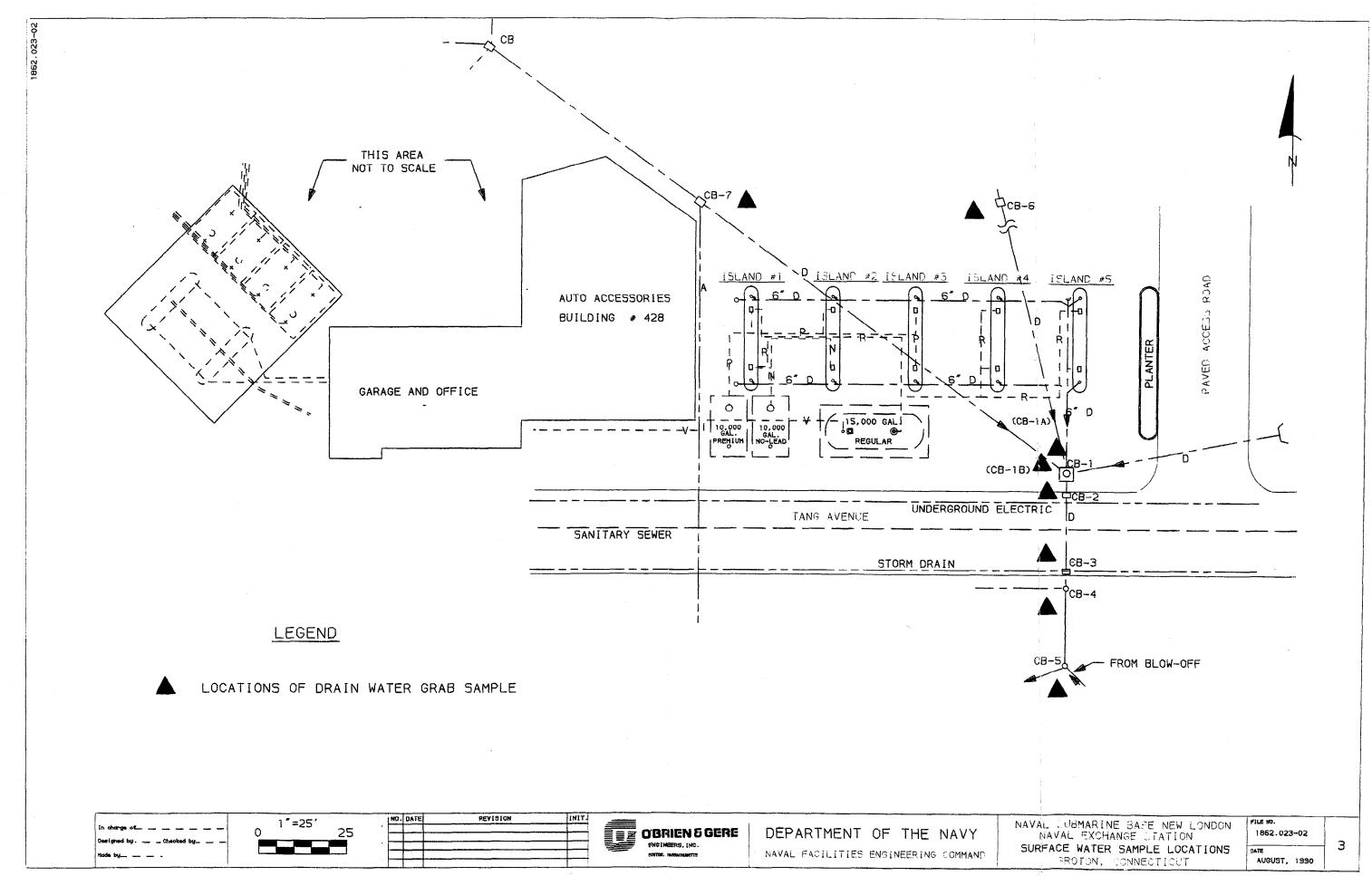
	FINGERPRINTED CO	<u>DNTAMINANTS</u>
MONITORING WELL #	SOIL	WATER
OBG - 1	Gasoline	Gasoline
OBG - 2		Gasoline
OBG - 6	Kerosene Diesel Fuel	
OBG - 9	Gasoline	
CB - 4		Gasoline Kerosene Diesel Fuel

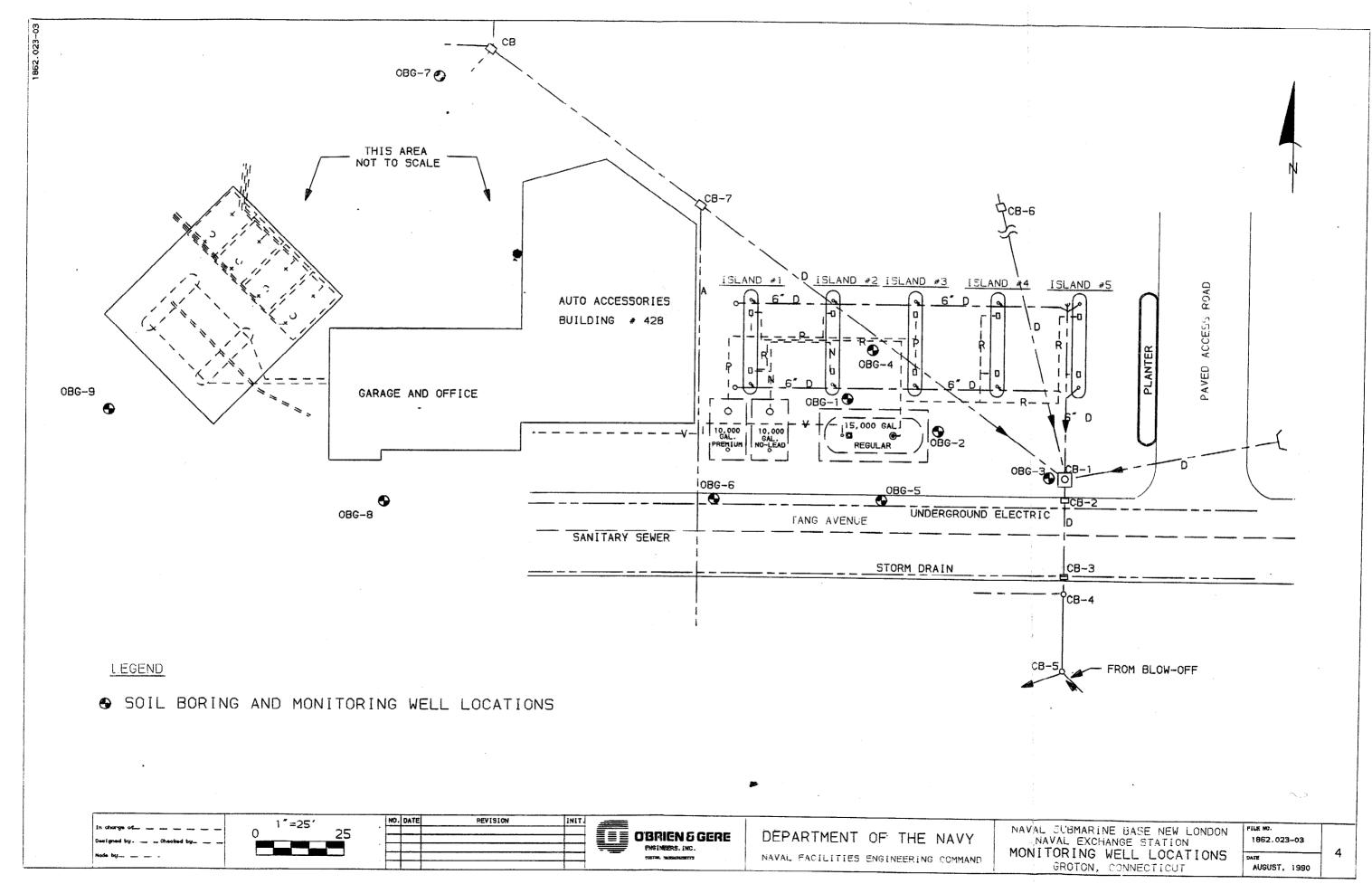
Figures

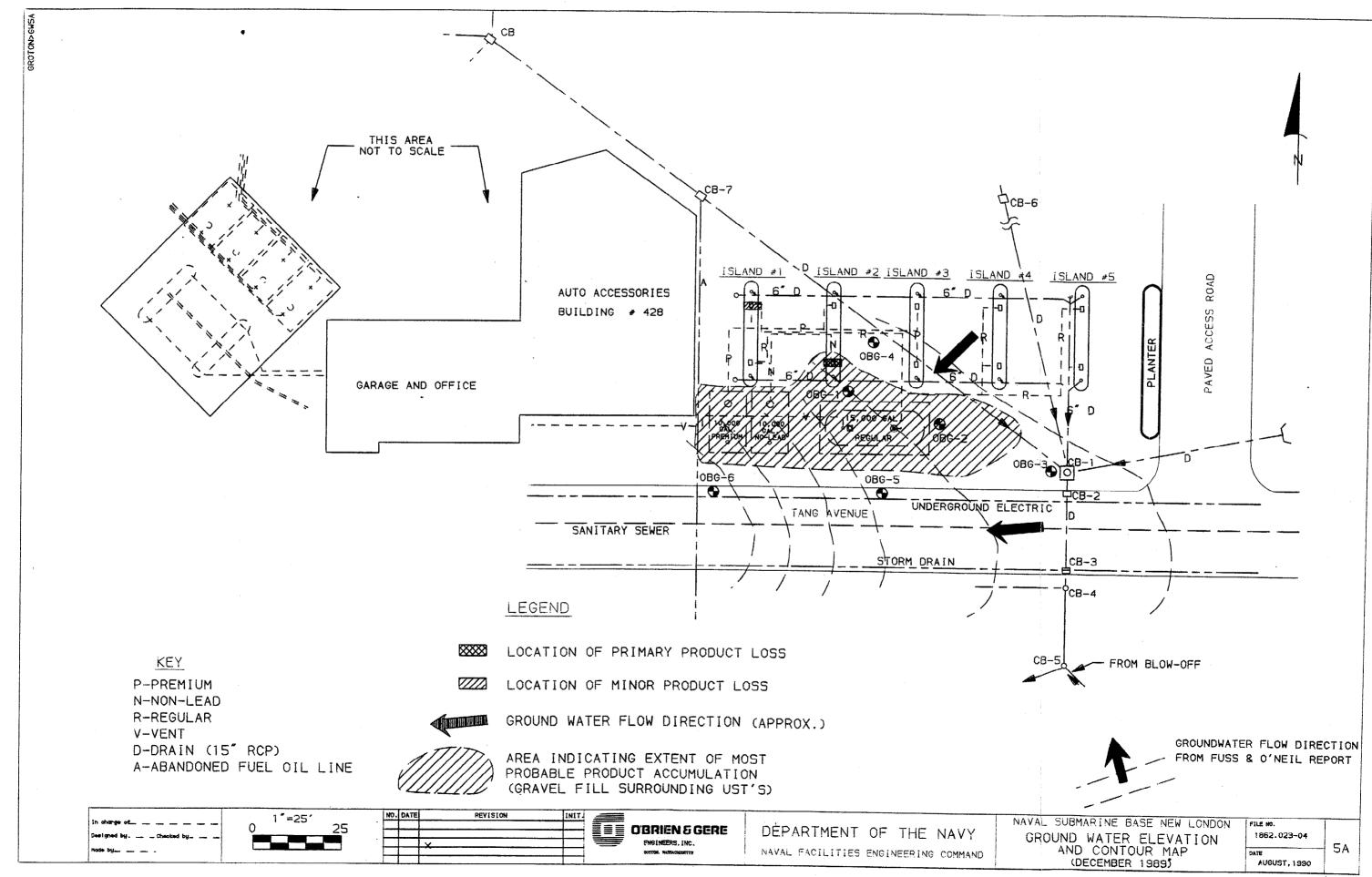


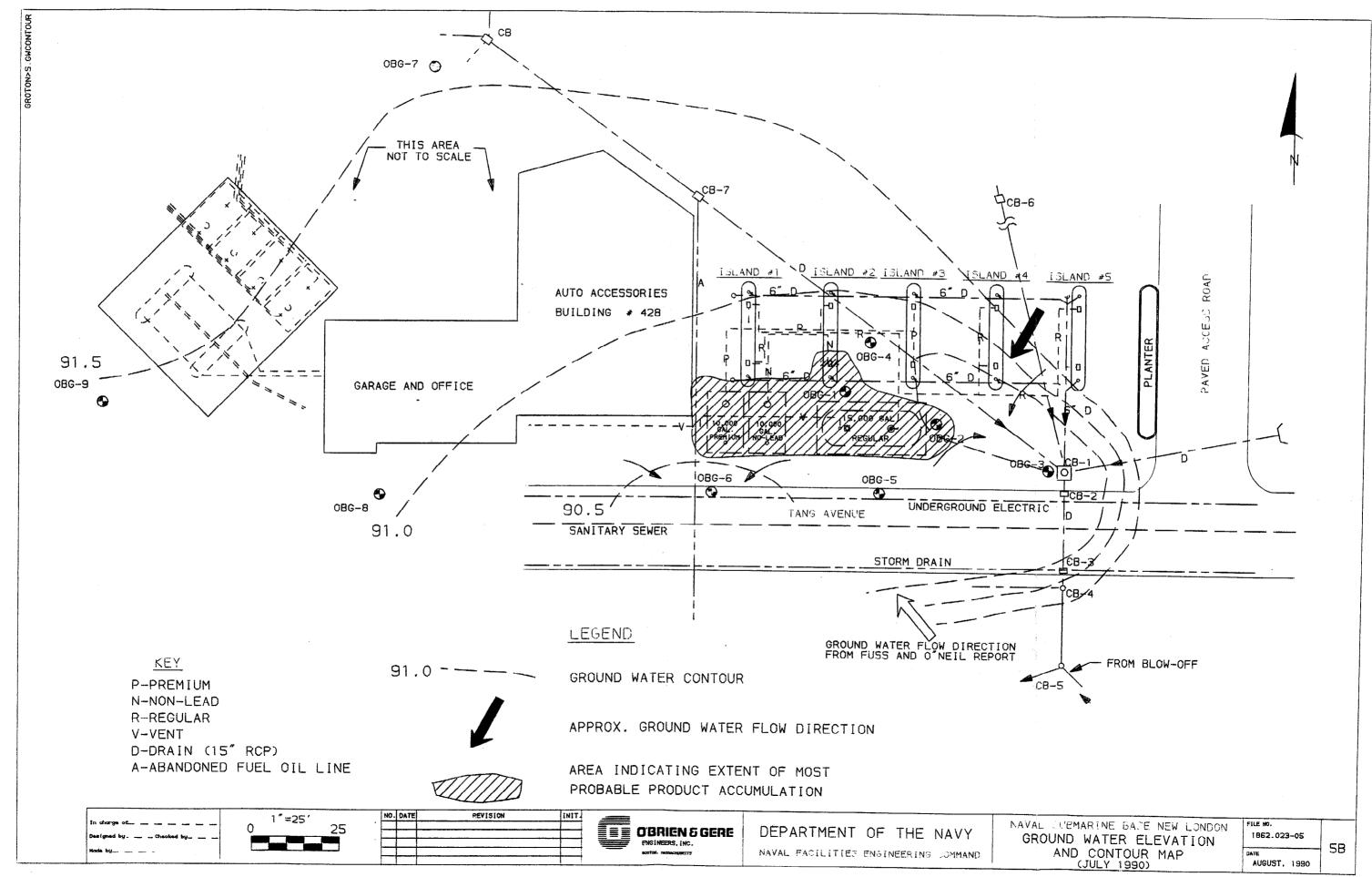


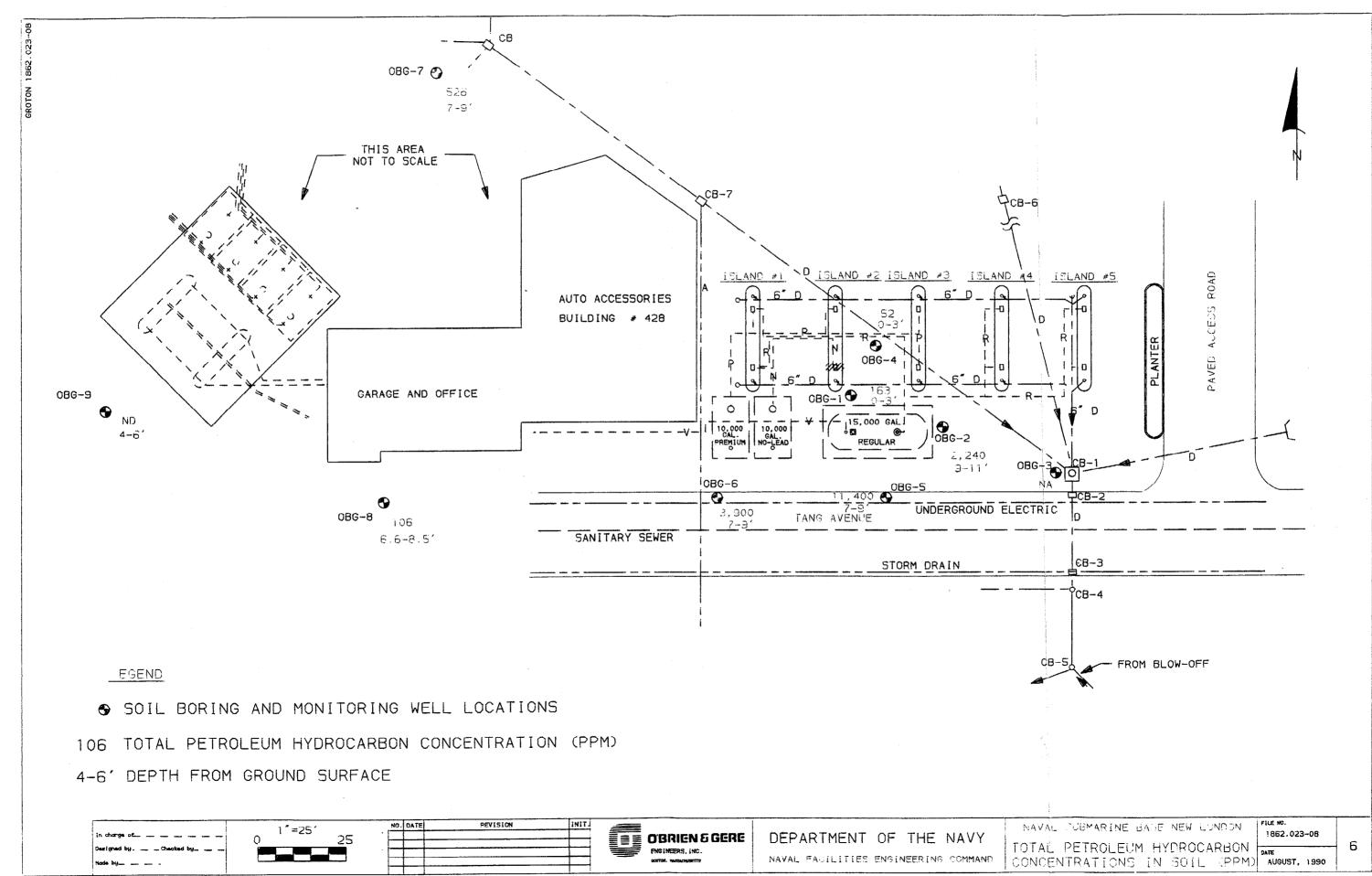


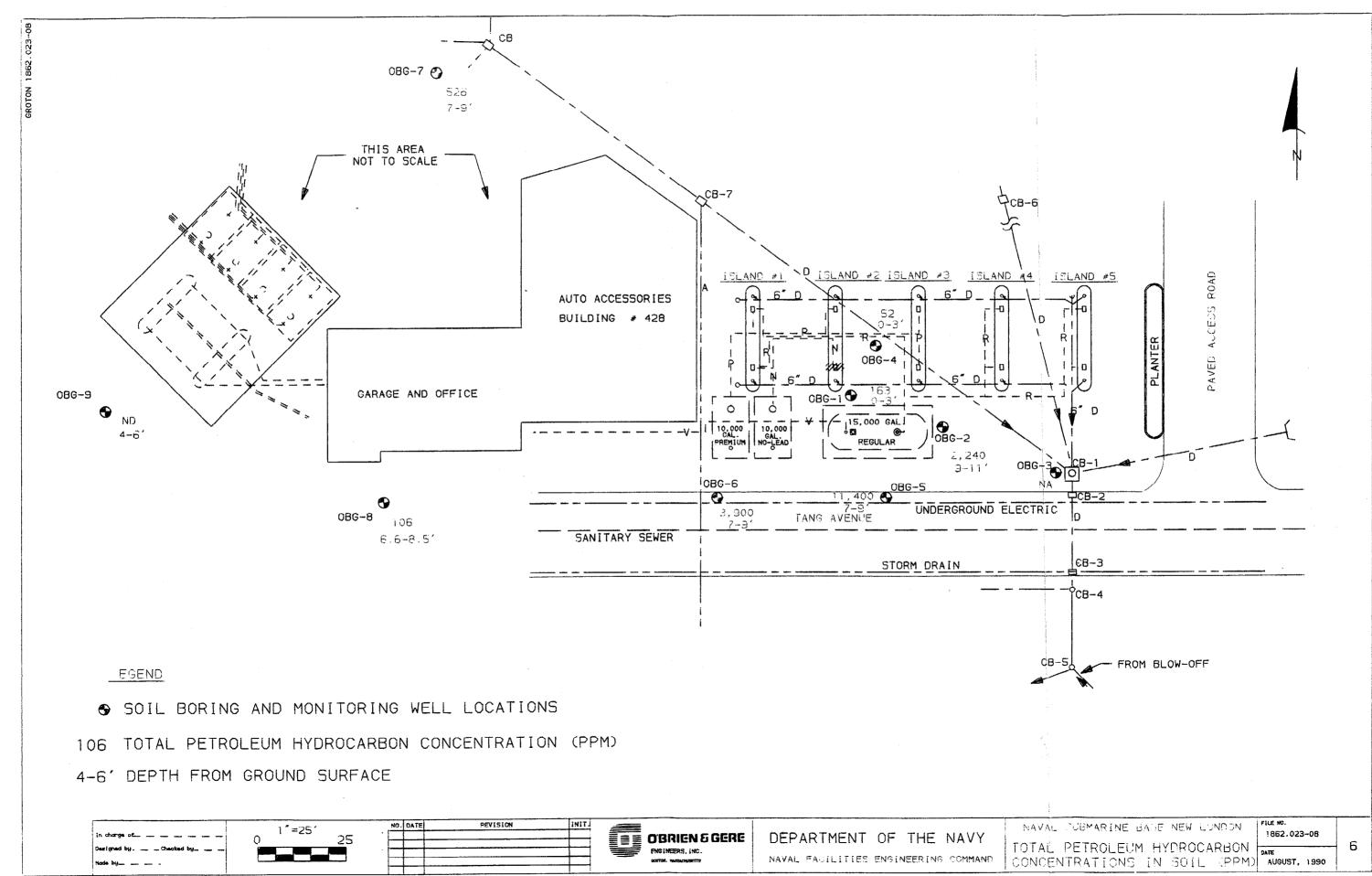


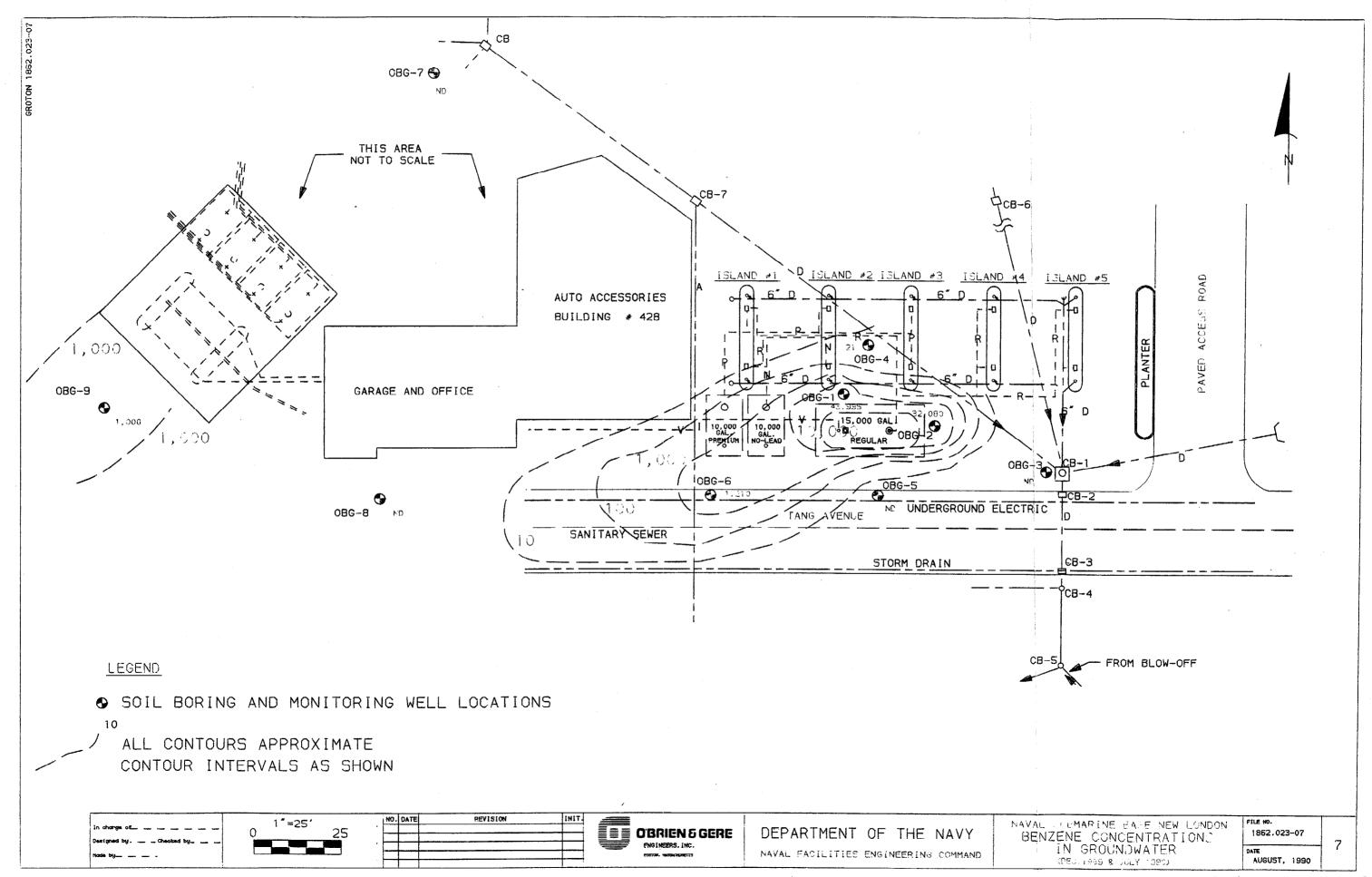


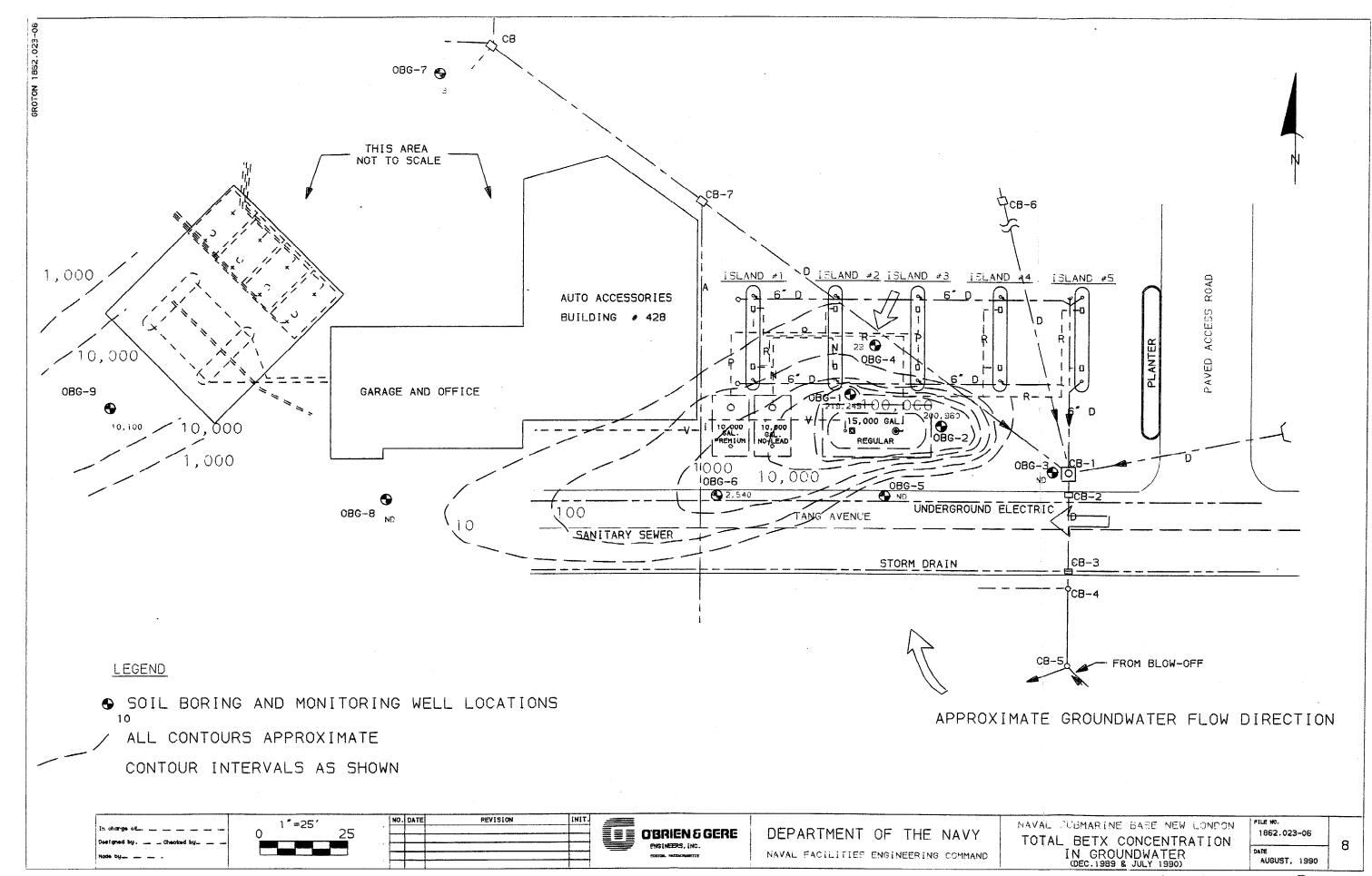


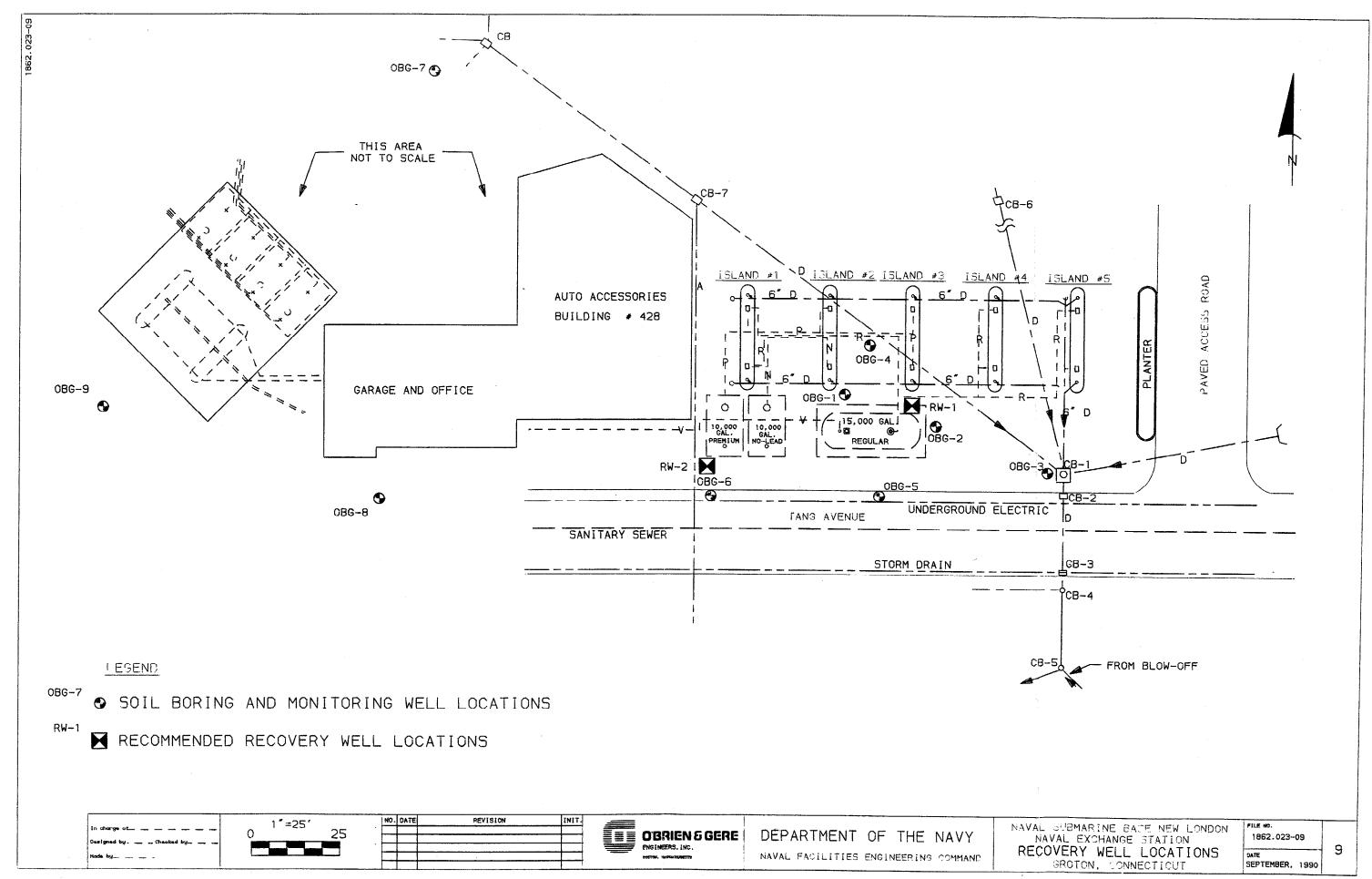












Appendices



APPENDIX A HEALTH & SAFETY PLAN

UNITED STATES DEPARTMENT OF THE NAVY NORTHERN DIVISION

NAVY EXCHANGE GAS STATION

UST INVESTIGATION

SUBMARINE BASE_NEW LONDON, GROTON, CONNECTICUT

UST INVESTIGATION AND REMEDIAL DESIGN EVALUATION

HEALTH AND SAFETY PLAN

1. INTRODUCTION AND BACKGROUND INFORMATION

A. Certification

This document serves as the Site Health and Safety Plan for the site investigation measures being conducted by O'Brien & Gere Engineers, Inc. at the Navy Exchange gas station at Submarine Base New London (SUBASENLON), Groton, Connecticut.

All personnel (here defined as employees of O'Brien & Gere Engineers, Inc. employees of all subcontractors, respondents, all visitors and representatives from the EPA, state, local groups, media, etc.) will be required to follow procedures set forth in this plan.

Site Name: Navy Exchange Gas Station

Location: Submarine Base New London, Groton, Connecticut

Project Description: Monitoring well installation, soil

borings and samplings, and surface water

and ground water sampling.

B. Key Personnel

Project Manager: Edward P. Zimmerman, P.E.

On-Site Project Coordinators and Safety and Health Officers: Rick G. Stromberg and/or Mark A. Randazzo

Naval Facilities Engineering Command Coordinator:
Joseph McCarthy

Off-Site Safety and Health Officer:

Mark A. McGowan, III, C.I.H.

O'Brien & Gere Engineers, Inc.

Syracuse, NY

(315) 451-4700 X549

C. Summary of Site Hazards

Potential chemical hazards at the site are related to the presence of volatile organic compounds (VOC's) and bulk petroleum hydrocarbons in soils and ground water. These represent potential contact and inhalation hazards.

Since the work is scheduled for late November/December, there may be hazards associated with exposure to cold and/or wet weather. Another potential hazard is the hazard associated with the operation of heavy equipment in a work area.

Potential combustion hazards exist at the site due to the presence of gasoline vapors in concentrations greater than the lower explosive limit (LEL). The LEL was exceeded during testing by the SUBASENLON Fire Department and Safety Office during October 11-16, 1989. The gasoline vapor concentrations were below the LEL on October 24, 1989.

D. Project Description and Purpose

The objective of the work to be completed at the project site is to identify and quantify the extent of pollutant concentrations in the soil and ground water. Data retrieved will be used to develop alternative site remediations.

The second secon

The field investigation will consist of the installation of ten soil borings and ten monitoring wells with soil samples being secured. This will be followed by the sampling of surface water and ground water.

II. HAZARD EVALUATION

A. Hazardous Material On-Site

Overall, the potential site concerns are represented by the presence of volatile organic carbons (VOC's) and petroleum resulting from the 10/10/89 gasoline leak.

These components may be found entrained in the soils and dissolved in the ground water, and could exist as a floating fraction on the ground water table. It should be noted that a sheen was noticed on the water in the weir installed in MHC 835. Figure 2 shows the location of MHC 835.

C. Site Hazard Status

Overall, the potential site concerns are represented by the potential presence of volatile organic carbons and petroleum. It should be noted that the chemical compounds are not anticipated to be present in concentrations presenting an acute respiratory hazard to site personnel under the conditions anticipated for the work. Contact with contaminated soils and water is anticipated, and protective clothing to minimize contact and prevent the spread of contamination will be used.

Due to the presence of gasoline vapors above the lower explosive limit, the potential for explosions must be considered. A blower in MHC 835 will be operating to reduce gasoline vapor concentrations below the LEL while obtaining grab samples from the storm sewer surface waters. Sparkless equipment will be used on-site. Oxygen meters and explosimeters will be used while obtaining grab

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samples from the storm sewers to ensure safe oxygen concentrations exist and the LEL is not being exceeded, respectively.

Other site hazards consist of inclement weather and dangers associated with heavy equipment. Extra layers of clothing and other proper safety equipment shall be worn as necessary and appropriate to the site conditions and as deemed necessary according to the on-site Health and Safety Officer.

D. Respiratory Protection

For initial site activities, no respiratory protection will be required. A monitoring program will be instituted during all surface disturbing activities using a TIP organic vapor detector. Readings will be taken every half-hour in order to monitor the presence of organic vapors. Visual inspections will also be performed to note unnatural soil conditions being exposed at the surface. In the event that either monitoring scheme indicate organic concentrations above specified action levels, the following responses should be implemented:

	ACT	ION	1 L	EVE	LS
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ACTION LEVELS			
Contaminant Total	Concentration	Location	Response
Organics	1-5ppm Above	Active	Obtain a second sample
	Background	Work	within a time period of no
		Area,	less than 5 minutes but no
		Breathing	more than 15 minutes, if the
		Zone	second sample reading exceeds
			1ppm above background on-site
			workers wearing Level D shall
			upgrade to Level C protection.

Take appropriate action as directed by the Safety & Health Officer in accordance with the Health & Safety Plan.

Contaminant Total	Concentration	Location	Response
Organics	5-50ppm Above	Active	Obtain a second sample
	Background	Work	within a time period of no
• •		Area,	less than 5 minutes but no
		Breathing	more than 15 minutes. If the
		Zone	second sample reading exceeds
			5 ppm above background, sampling
			will be performed at 15 minute
			intervals until levels fall below
			5ppm
			Take appropriate action as
			directed by the Safety & Health
			Officer in accordance with the
			Safety & Health Officer Health &
			Safety Plan.
	50ppm (Above	Active	Active work area shall be
	Background)	Work	shutdown and personnel
	for two suc-	Area,	evacuated up wind until
	cessive read-	Breathing	conditions are favorable to
	ings within 15 minute period	Zone	Level C protection.

E. Contact Protection

1. Monitoring Well Installation & Test Pit Excavation

All personnel will have appropriate personal safety equipment and protective clothing; as specified for Level D as follows. Each individual will be properly trained in the use of this safety equipment before the start of field activities. Safety equipment and protective clothing shall be used as directed by the on-site Health and Safety Officer. Such equipment and clothing shall be cleaned and will be maintained in proper condition by project personnel.

Protective footwear and clothing will be required at all times during this investigation. Hard hats and necessary hearing protection (ear plugs or earmuffs) will be worn during operation of all heavy equipment. Protective glasses shall be worn when the potential for a splash or for flying particles exists due to site activities. The types of equipment and clothing to be worn as part of the various levels of protection are given below:

Level C Protection

- a) Full-face air purifying respirator equipped with organic vapor cartridges if air monitoring readings in the breathing zone are between 1 and 10ppm (all personnel requiring respiratory protection are fit tested with the respirator to be used in the field, and must be approved for use of a respirator following a pulmonary function test). If air monitoring reveals organic vapor concentrations between 10-50ppm, a full face respirator with organic vapor cartridges will be used.
- b) Chemical-resistant disposable coveralls, long sleeves, one piece with tape between suits and boots and gloves.
- c) Steel-toe boots with disposable rubber overboots.
- d) Nitrile gloves over warm work gloves.

Level D Protection

- a) Long sleeve work shirt and long pants (work pants or jeans).
- b) Steel-toe boots with rubber overboots.

- c) Viton gloves over warm work gloves.
 - d) Coveralls to be cleaned or disposed of immediately following site work (cloth or chemical resistant).

F. Heat Stress/Cold Exposure

Precautions to be taken against heat stress due to the use of personal protection include:

- training in the recognition and treatment of the various forms of heat stress for all on-site personnel;
- access to adequate supplies of water for all workers;
- prudent work/rest scheduling;
- availability of a shaded rest area (to include the field vehicle);
- self-monitoring of pulse by all workers in Level C protective equipment. As a general guideline, a pulse of 110 beats per minute or greater, following a rest period, is a signal to shorten the next work cycle by a third.

Precaution to be taken against excessive cold exposure include:

- training of all on-site workers in the recognition and treatment of cold exposure;
- availability of a warm, dry rest area.
- extended or more frequent rest periods.

III. STANDARD OPERATING PROCEDURES

A. Health and Safety Management and Responsibilities

The on-site project coordinator(s) will implement the safety program, make sure proper clothing and supplies are available and maintained, and inform the workers of existing site conditions. The on-site coordinator(s) will be responsible for overseeing compliance with these protocols.

B. Requirements for Entry into Work Zones

Entry into the work area will be permitted only to those personnel wearing the required clothing and protective equipment. Persons not connected with the work being done on the site will not be permitted access to the work area. The work area will be a minimum of 50 ft. radius around the drill rig and marked off by flags, stakes or cones.

C. Monitoring/Action Levels

Monitoring will be conducted as previously discussed. A photoionization meter will monitor for organic vapor concentrations during the monitoring well installations.

Instrument	Component Monitored	Safe Level	Respirator Protect.
TIP II (Photoionization Meter)	Organic Vapor	1-10ppm	Full-face respirator protection with organic vapor cartridge
TIP II (Photoionization Meter)	Organic Vapor	10-50ppm	Full-face respirator protection with organic vapor cartridge

Daily monitoring results will be placed in the project file. Daily summaries of monitoring results will be recorded in the project log book.

D. Decontamination Procedures

Decontamination procedure for personnel wearing protective equipment are as follows.

- 1. Wash and rinse gloves and boots.
- 2. Remove overboots and overgloves. Remove coverall or tyvek and discard in plastic lined container.
- 3. Remove respirator (if worn) and place on plastic sheet for cleaning. Remove organic vapor cartridges and dispose of properly.
- 4. Wash hands and face. Decontamination waste waters will be collected and disposed of according to applicable regulations.

IV. CONTINGENCY PLAN

A. Introduction

A Contingency Plan has been developed in the event of an unplanned release of contaminants to the environmental or the development of an emergency situation during on-site operations. The Contingency Plan describes policies and procedures used to respond to emergency situations. Types of emergency situations which might arise include:

- major medical emergency
- liquid or solid hazardous materials spill
- severe inclement weather

When an emergency occurs, decisive action is required. Delays of minutes can create life threatening situations. A response needs to be immediate and accurate.

1. Emergency Response

The on-site project coordinator will be responsible for implementation of control over emergency situations. In an emergency this individual must be notified of the following essential information:

What happened:

- Type of incident
- When incident occurred
- Where incident occurred
- Cause of incident (to be verified by subsequent investigation)
- Extent of damage
- Extent of chemical release

Casualties:

- Victims (number, location, and condition)
- Treatment Administered
- Treatment Required
- Missing Personnel

After assessing the emergency, the on-site project coordinator, in conjunction with the project manager, will notify the appropriate emergency response personnel. The on-site project coordinator will alert on-site personnel as to the nature of the emergency and provide instructions regarding evacuation and/or rescue. In the event that evacuation is necessary, work should be stopped immediately and the site evacuated.

2. Emergency Communication

The following standard hand signals will be used in case a worker is unable to speak:

- Hand gripping throat out of air, can't breathe.
 - Grip partner's wrist or place hands around waist leave area immediately.
 - Index finger across throat and rolling of hands stop work, leave area immediately.
 - Hands on top of head need assistance.
 - Thumbs up OK, I'm all right, I understand
 - Thumbs down no, negative

B. Site Emergency Evacuation

In case of an emergency, all personnel should evacuate the site to an immediately adjacent area as instructed by the on-site coordinator.

It is the responsibility of the on-site project coordinator to inform all personnel entering the work site of potential hazard areas and the locations of project work areas.

The on-site project coordinator is responsible for controlling the entry of personnel into the Work Area and knowing the location of on-site personnel at all times.

In the event that an incident threatens the health or safety of the surrounding community, the public will be informed and emergency procedures will be coordinated with the appropriate off-site agencies. The on-site project coordinator in conjunction with the project manager will coordinate these efforts.

C. Medical/First Aid

Required medical treatment may range from bandaging minor cuts to providing life saving first aid and immediate medical transport. There should be at minimum one individual on-site at all times who is responsible for emergency first aid procedures. These persons should be identified as such for the information of others on-site.

(Should an injury occur, the transportation route to the nearest hospital is identified in Table 1 (i.e., Emergency Response Organization).

The following is a general description of first aid measures to be employed on the site. In cases of symptoms of chemical exposure, first aid treatment is to be followed by a full medical examination. The person(s) accompanying a victim to the hospital must be able to inform hospital personnel of the nature of the contamination of the site. If necessary, a copy of this Health and Safety Plan can be given to hospital personnel.

1. Inhalation

Symptoms: dizziness, nausea, lack of coordination, headache, irregular rapid breathing, coughing, choking, weakness, loss of consciousness, coma.

Treatment:

- a. Bring victim to fresh air. Rinse eyes or throat if irritated.
- b. Be prepared to administer CPR, only if CPR certified.
- c. Take victim to hospital.

2. Contact

Symptoms: Same as above. On skin, solvents may produce irritation, rash or burning. For eyes, symptoms may include redness, irritation, pain or impaired vision.

Treatment:

- a. Flush affected area with cool water for at least 5 minutes.
- b. Cover skin injuries with a clean dressing.
- c. If injury is severe, take victim to hospital. If not, seek other medical attention.
- d. Monitor victim for at least 48 hours.

3. Ingestion

Symptoms: Same as above, with stomach cramps.

- a. Take victim to hospital immediately.
- b. Do not induce vomiting.

D. Emergency Procedures

Emergency procedures which may be useful in the event of an emergency situation previously described are included below. While it is impossible to anticipate every emergency situation which might arise, the procedures deal with the significant components of most emergency situations.

1. Major Medical Emergency

A major medical emergency could arise from any number of situations. Swift, decisive action must take place to administer aid to injured personnel and prevent injury from spreading to additional personnel. The following procedure may be useful in effective handling of a medical emergency:

Remove injured personnel from hazard areas as soon as possible. Rescue personnel must be protected from the hazard. Discretion must be used in the method of movement (e.g., moving personnel with spinal injuries should only be done by trained personnel unless the situation is immediately life threatening). First aid should be administered as soon as victim is moved to safety. The appropriate Emergency Response Organization (e.g., Ambulance, Hospital) should be notified and utilized as necessary.

2. Severe Inclement Weather

On-site personnel should be updated on current weather fore-casts. Preparations should be made ahead of time in the event of the forecast of severe inclement weather (i.e., heavy precipitation, high winds, frigid temperatures) to protect on-site facilities and ensure worker safety. On-site personnel should seek refuge in the facility whenever weather conditions compromise worker safety.

3. Emergency Decontamination Procedure

Immediate decontamination is to be done when it is an essential part of lifesaving first-aid, but should not be done if it would interfere with necessary medical treatment.

If decontamination can be done: wash, rinse, and/or cut off protective clothing and/or equipment. If decontamination cannot be done (only in a case of inhalation exposure), wrap the victim in blankets, plastic, or other barrier materials to reduce the potential for contamination of other personnel. In addition, emergency and off-site medical personnel. In addition, emergency and off-site medical personnel need to be alerted to specific decontamination procedures to follow.

E. Follow-Up Procedures

Before normal site activities are resumed, personnel must be fully prepared and equipped to handle another emergency. Any necessary emergency equipment must be recharged, refilled, or replaced. Government agencies, such as Occupational Safety and Health Administration (OSHA), Environmental Protection Agency (EPA), Department of Transportation (DOT) and state agencies, must be notified as appropriate.

An investigation of the incident needs to be conducted as soon as possible. The report may be used as training and information tools to prevent a future recurrence, as evidence in future legal action, for assessment of liability by insurance companies, and for review by government agencies. Therefore, the document needs to be accurate, objective, complete and authenticated (signed and dated).

With the direction of the "on-site" coordinator, all personnel entering the site must be informed about emergency procedures. Visitors need to be briefed on basic emergency procedures such a decontamination, emergency signals, and evacuation routes. Personnel without defined emergency response roles need to receive training which includes: hazard recognition, understanding of emergency procedures, knowledge of evacuation routes and how to report an emergency. Off-site emergency personnel who are potential first responders need to be informed about site-specific hazards, appropriate response techniques, site emergency procedures, and site decontamination procedures.

F. On-Site Emergency Equipment

The following emergency equipment will be on-site during field operations:

- Fire Extinguishers: Class ABC fire extinguisher(s) will be readily available on-site throughout the investigation. The fire extinguisher(s) will be kept with the field crew during any drilling activity.
- First Aid Kits: An industrial first aid kit with sufficient supplies for 5 people will be kept in the support area. Additionally, at least one individual First Aid/CPR qualified, will be on-site during project operations.
- Portable Eye Wash Kit: A portable eye wash kit will be readily available on-site throughout the investigation. The kit will be kept with the field crew during any drilling activity. Permanent eye wash facilities are also available for use on-site.

TABLE 1 EMERGENCY RESPONSE ORGANIZATIONS

Organization	Phone Number
SUBASENLON Fire Department	2222
BODABENDON Fire Department	
SUBASENLON Police Department	3444
Poison Control	1-800-343-2722
SUBASENLON Fire Department, Rescue	e Squad3333
Lawrence Memorial Hospital	
365 Montawk Avenue	
New London, CT	(203) 492-0711
Lawrence Memorial Hospital	
365 Montawk Avenue	
New London, Ct	(203) 442-0711
O'Brien & Gere Engineers, Inc.	
(Thomas A. Jordan, Richard G. Stromb	perg,
Mark A. Randazzo)	
100 Summer Street	
Boston, MA	(617) 423-2919
Navy D.P.W.	
William Mansfield	(203) 449-4481
James Fitzpatrick	.(203) 449-4486
NAVFAC	
Joseph McCarthy	
Philadelphia, PA	(215) 897-6280

Directions to Lawrence Memorial Hospital:

Left onto Crystal Lake Road and right onto Route 12 South to Route 95 South. Cross bridge over Thames River and take exit for Frontage Row. Follow signs to Coleman Street and take a left. At the end of Coleman Street, take a right onto Montawk Avenue. Hospital is on the right.

APPENDIX B

PROTOCOLS

SURFACE WATER SAMPLING PROTOCOL

When sampling from an open body of water (stream, culvert or pond) care must be exercised to collect a representative sample. The sample should cause as little disturbance to the water body as possible. Avoid taking a sample of water which shows evidence of sediment, debris or other material which may have been stirred up by the presence of the sampler.

Surface Water Sampling

Surface water samples in the drains should be taken from point located in the middle of the culvert. The specific location will be determined in the field and should be adequate to accurately reflect a representative portion of the water body being sampled. A single sample, collected just below the surface at the stream's midpoint will be adequate for sampling and analyses purposes.

Samples should be taken while facing upstream, away from the influence of the sampler on stream flow. Samples should be collected from the downstream culvert first and proceed upstream so as not to affect subsequent samples.

Collection is accomplished by submerging a clean container at the sampling point to the depth required. For deep streams or ponds, a Kemmer, VanDorn or other sampler specifically designed for this purpose may be used. For shallow (i.e. less than three feet deep) locations, an inverted sample container may be carefully submerged by hand or nylon string and then slowly allowed to fill.

Samples should then be placed in the proper containers, preserved as necessary for the analyses to be run and stored in an insulated ice cooler at 4° C. All pertinent information should be recorded including sample data and location, sample identification and chain-of-custody forms.

Surface water sampling in storm drains will require two men since the storm sewers are confined spaces. The person descending into the manhole will be connected to rope and lanyard which will be monitored by the person outside the catch basin. Constant visual contact between the two individuals is required and the time in the storm sewer should be minimized. Due to the previous presence of volatile organic compounds in the storm sewer system, the person collecting samples should wear a full-face respirator with organic vapor cartridges.

SOIL BORING PROTOCOL

I. Drilling/Sampling Procedures

Prior to initiating drilling, all locations will be cleared of above ground and underground utilities. All appropriate health and safety precautions will be followed in accordance with those presented in the Health and Safety Plan.

Test borings shall be completed using conventional hollow stem auger drilling methods to a depth specified by the supervising geologist/engineer. The minimum inside diameter of the augers shall be 4-1/4 inches. Pre-coring of concrete may be required at some locations.

Samples of the encountered subsurface materials shall be collected continuously employing ASTM Method D-1586-84/Split Barrel Sampling using either a standard 2 ft. long, 2 in. outside diameter split spoon sampler with a 140 lb. hammer or a 3 in. outside diameter sampler with a 300 lb. hammer. Upon retrieval of the sampling barrel, the collected sample shall be placed in glass jars, labelled, retained on site and stored by O'Brien & Gere for possible testing. If laboratory soil samples are to be analyzed samples shall be placed in the laboratory sample containers as specified by the supervising hydrogeologist, labeled and placed on ice. Chain of custody procedures will be practiced following procedures outlined in Appendix H.

A geologist will be on site during the drilling operations to fully describe each soil sample including 1) Soil type, 2) color, 3) percent recovery, 4) moisture content, 5) odor and 6) miscellaneous observations such as organic content, free product. The supervising geologist will be responsible for retaining a representative portion of each sample in a one pint glass jar labelled with 1) site, 2) boring number 3) interval sample/interval preserved, 4) date, and 5) time of sample collection.

The drilling contractor will be responsible for obtaining accurate and representative samples, informing the supervising geologist of changes in drilling pressure, keeping a separate general log of soils encountered including blow counts (i.e. the number of blows from a soil sampling drive weight (140 pounds) required to drive the split spoon sampler in 6-inch increments and installing monitoring wells to levels directed by the supervising geologist following specifications further outlined in this protocol.

To prevent cross contamination of soil samples, the split spoon samplers will be cleaned between samples and the drilling equipment (i.e. augers, casing and rods) will be decontaminated between borings. (Appendix C and D).

Those soil borings which are not to be converted to monitor wells will be backfilled by filling the borehole with a cement/bentonite mixture of suitable consistency.

MONITORING WELL INSTALLATION PROTOCOLS

The borings in which the wells will be placed shall be advanced using a minimum 4 1/4 inch hollow stem auger. Wells are anticipated to be installed to a depth of 17 to 20 feet or 10 feet below the water table.

All monitoring wells will be constructed to bracket the top of the water table using 10 feet of 2 inch I.D., 0.020 inch slotted flush jointed PVC screen attached to 2 inch I.D. PVC flush jointed riser pipe. A washed, graded silica sand pack will be placed around the well screen annulus. A two foot thick bentonite seal will be placed above the sand pack. A thick bentonite/cement grout will then be tremmied or poured from the top of the bentonite seal to near the ground surface. A flush-mounted locking protective steel casing will then be cemented into place over the PVC to prevent accidental damage and unauthorized access.

The following procedures will be used to obtain representative ground water samples. To obtain representative ground water samples from wells containing only a few gallons of ground water, the bailing procedure is effective (2" I.D. wells). To purge wells containing more than a few gallons, the pumping procedure is generally more rapid. Each of these procedures is explained in detail below.

Sampling Procedures (BAILER)

- 1. Identify the well and record the location on the Ground Water Sampling Field Log (copy attached).
- 2. Put on a new pair of disposable gloves.
- 3. Cut a slit in the center of a plastic sheet, and slip it over the well creating a clean surface onto which the sampling equipment can be positioned.
- 4. Using an electric well probe, measure the depth to the water table. Record this information in the Ground Water Sampling Field Log. Depth measurements will be taken before sampling starts so that this data is collected over the shortest period possible. This will allow for less data variability due to time.
- 5. Clean the well depth probe and wash it with detergent and rinse it with distilled water after use.
- 6. Compute the volume of water in the well, and record this volume on the Ground Water Sampling Field Log.
- 7. Attach enough polypropylene rope to a stainless steel bailer to reach the bottom of the well, and lower the bailer slowly into the well making certain to submerge it only far enough to fill one-half full.
- 8. Pull the bailer out of the well keeping the polypropylene rope on the plastic sheet or entirely off the ground if it is too windy to place a plastic sheet. Empty the boiler into a glass container and observe the physical appearance of the ground water.
- 9. Record the physical appearance of the ground water on the Ground Water Sampling Field Log.
- 10. Attach the polypropylene rope to a clean, stainless steel bailer, lower the bailer to the bottom of the well, and agitate the bailer up and down to resuspend any material settled in the well.
- 11. Initiate bailing the well from the well bottom making certain to keep the polypropylene rope on the plastic sheet. All ground

water should be poured from the bailer into a graduated pail to measure the quantity of water removed from the well.

- 12. Continue bailing the well throughout the water column and from the bottom until a sufficient volume of ground water in the well has been removed, or until the well is bailed dry. If the well is bailed dry, allow sufficient time for the well to recover before proceeding with the next step. Record this information on the Ground Water Sampling Field Log.
- 13. Remove the sampling bottles from their transport containers, and prepare the bottles for receiving samples. Inspect all labels to insure proper sample identification. Sample bottles should be kept cool with their caps on until they are ready to receive samples. Arrange the sampling containers to allow for convenient filling. Always fill the containers labeled "volatiles" (40 ml VOA bottles) first.
- 14. To minimize further agitation of the water in the well, initiate sampling by lowering the stainless steel bailer slowly into the well making certain to submerge it only far enough to fill it completely.
- 15. If the sample bottle cannot be filled quickly, keep them cool with the caps on until they are filled. The vials labeled "volatiles" analysis should be filled from one bailer then securely capped. Carefully fill the 40 ml VOA vials to minimize agitation. This is usually done by pouring the sample into a tilted VOA vial. Cap the VOA vial, turn it upside down, and check for air bubbles. If properly filled, there should be no visible air bubbles. Return each sample bottle to its proper transport container. Samples must not be allowed to freeze.
- 16. Record the physical appearance of the ground water observed during sampling on the Ground Water Sampling Field Log. Collect a final sample and measure pH, temperature and specific conductance.
- 17. Begin the Chain of Custody Record.
- 18. Clean the bailer according to methods in the Sampling Equipment Protocol. Store the bailer in a clean, dry place.
- 19. Replace the well cap, and lock the well protection assembly before leaving the well location.
- 20. Place the polypropylene rope, gloves, and plastic sheeting into a plastic bag for disposal.

Purging Procedures (PUMP)

- 1. Identify the well and record the location on the Ground Water Sampling Field Log (copy attached).
- 2. Put on a new pair of disposable gloves.
- 3. Cut a slit in the center of a plastic sheet, and slip it over the well creating a clean surface onto which the sampling equipment can be positioned.
- 4. Using an electric well probe, measure the depth to the water table. Record this information in the Ground Water Sampling Field Log. As previously mentioned, all depth to water table and well depth measurements will be taken for all wells before sampling begins.
- 5. Clean the well depth probe and rinse it with distilled water after use.
- 6. Compute the volume of water in the well, and record this volume on the Ground Water Sampling Field Log.
- 7. Attach enough polypropylene rope to a stainless steel bailer to reach just below the surface of the water table, and lower the bailer slowly into the well making certain to submerge it only far enough to fill it one-half full.
- 8. Pull the bailer out of the well keeping the polypropylene rope on the plastic sheet. Empty the bailer into a glass container and observe the physical appearance of the ground water.
- 9. Record the physical appearance of the ground water on the Ground Water Sampling Field Log.
- 10. Prepare the pump for operation. Connect the dedicated polyethylene tubing to a delrin foot valve.
- 11. Lower the pump to the top of the water level in the well and pump the ground water into a graduated pail. Pumping should continue until sufficient well volumes have been removed or the well is pumped dry. If the well is pumped dry, allow sufficient time for the well to recover before proceeding with Step 13. Record this information on the Ground Water Sampling Field Log.
- 12. Remove the sampling bottles from their transport containers, and prepare the bottles for receiving samples. Inspect all labels to insure proper sample identification. Sample bottles should be kept cool with their caps on until they are ready to receive samples. Arrange the sampling containers to allow for

- convenient filling. Always fill the vials labelled "volatiles" (40 ml VOA vials) first.
- 13. Samples should be collected_by a stainless steel bailer. To minimize agitation of the water in the well, initiate sampling using a gentle bailing action.
- 14. If the sample bottle cannot be filled quickly, keep them cool with the caps on until they are filled. Return each sample bottle to its proper transport container. Samples must not be allowed to freeze.
- 15. Record the physical appearance of the ground water observed during sampling on the Ground Water Sampling Field Log. Collect a final sample and measure pH, temperature and specific conductance.
- 16. Begin the Chain of Custody Record.
- 17. Clean the bailer by methods described in the Equipment Cleaning Protocol. Store the bailer in a clean, dry place. Decontaminate the purge pump following the above method or by pumping a minimum of 5 volumes of potable water.
- 18. Replace the well cap, and lock the well protection assembly before leaving the well location.
- 19. Place the polypropylene rope, gloves, and plastic sheet into a plastic bag for disposal.

GROUND WATER SAMPLING PROTOCOL

Sampling Procedures (Well With Product)

- 1. Identify the well and record the location on the Ground Water Sampling Field Log (copy attached).
- 2. Put on a pair of clean gloves or new disposable gloves. The gloves shall be cleaned using Methanol followed by a clean water rinse.
- 3. Cut a slit in the center of plastic sheet, and slip it over the well creating a clean surface onto which the sampling equipment can be positioned. In the event that it is not practical to use plastic sheeting (winter), the new polypropylene rope will be kept from touching the ground surface.
- 4. Using a clean electronic well probe, measure the depth to the water table and the bottom of the well (if not previously measured) from the top of the protective casing or a surveyors mark. If free phased product is present use an oil-water interface probe or a clear bottom loading bailer to determine the thickness of the product. The electronic well probe will be cleaned using a detergent wash and distilled water rinse followed by a hexane rinse and distilled water rinse.
- Compute the volume of water in the well, and record this volume on the Ground Water Sampling Field Log.
- 6. Attach enough new polypropylene rope to a clean bottom loading stainless steel bailer to reach the bottom of the well.
- 7. Lower the bailer slowly into the well making certain to submerge it only far enough to fill one-half full. The purpose of this is to recover for observation any oil film, if one is present on the water table.
- 8. Pull the bailer out of the well keeping the polypropylene rope on the plastic sheeting or off the ground. Empty the ground water from the bailer into a clean glass container and records its appearance on the Ground Water Sampling Field Log.
- 9. With the intake area protected, install a foot valve and tygon tubing assembly in the well such that the intake is below the water table. Remove the intake protections and begin purging. All ground water should be poured from the bailer into a graduated pail to measure the quantity of water removed from the well. Ground water will be contained.

- 10. Continue pumping the well until 3 well volumes have been removed, or until the well is pumped dry to the intake areas. If the well is pumped dry, allow sufficient time for the well to recover before proceeding with the next step. Ph and specific conductance readings shall be taken prior to the collection of the actual sample. Record this information on the Ground Water Sampling Field Log.
- 11. Remove the sampling bottles from their transport containers, and prepare the bottles for receiving samples. Inspect all labels to insure proper sample identification. Arrange the sampling containers to allow for convenient filling.
- 12. Collect samples from the pump discharge. The vials labeled "volatiles" should be filled from one bailer then securely capped. The vial should be turned upside down, and checked for air bubbles. If properly filled there should be no visible air bubbles. Place each container in a cooler and chill to 4 C. Samples must not be allowed to freeze.
- 13. After the last sample has been collected record the physical appearance of the ground water observed during sampling on the Ground Water Sampling Log.
- 14. Begin Chain of Custody Record.
- 15. Replace the well cap, and lock the protection assembly before leaving the well location.
- Place the polypropylene rope, gloves, etc into a plastic bag for disposal.

IN-SITU HYDRAULIC CONDUCTIVITY TESTING PROTOCOL (UNCONFINED AQUIFERS)

This type of test will be used to evaluate the hydraulic conductivity of an unconfined, unconsolidated aquifer in the immediate area of a monitoring well. The goal of the test will be to create a sufficient head difference between the aquifer and the well such that inflow to that well over a certain time interval is representative of aquifer hydraulic conductivity.

The test will be performed by removing a volume of water from the well by use of a clean pump or bailer. If a sufficient difference in head is obtained by this method (at least 10-25% of the length of water column in the well) then recovery data can be collected. In this case, the subsequent rise of the water level in the well with time will be measured by a cleaned measuring device until the head difference approaches zero (rapid recovery) and at least 75% of the original head difference (slow recovery). Measurements shall be collected at frequent time intervals at the start of the test and increased appropriately according to the rate of recovery in the well.

If no significant drawdown is anticipated or can be obtained by this method, an Enviro-Labs Model DL-120-MCP pressure transducer system or equivalent will be utilized. All equipment will be pre-cleaned by an appropriate method prior to use in the well. The test will involve pre-insertion of a pressure transducer into the well followed by insertion of a suitably sized, tapered teflon rod into the well in order to create a positive flow potential from the well into the aquifer. Following measurement by the transducing system, the teflon rod will be removed in order to create a negative flow potential. These tests will be performed at least two times to evaluate the repeatability of response.

Data from the foregoing tests will be evaluated using Hvorslev's graphic analysis of piezometer recovery data (Ground Water Freeze and Cherry, 1979 pp 339-342, after Hvorslev M.J., "Time Lag and Soil Permeability in Ground Water Observations", 1951). The data will be plotted on a logarithmic scale including the ratio of recovered head to original head versus time. The time lag which represents the time for complete equalization of the head difference if the original inflow is maintained will be developed following evaluation of the resulting straight line plot. This value together with the length of screen, screen diameter including sand pack, and riser diameter will be used in Hvorslev's equation to develop the hydraulic conductivity(k) in cm/sec.

APPENDIX C SURFACE WATER SAMPLING FIELD LOGS



ient NAUFAC	Job No.
imple Location Naval Exchange	Gas Station Well No. CB-1A
impled By Mark A. Randa	670 Date 12/15/89 Time
	Sampled with Bailer Pump
WATER TABLE	·
ell depth (from top of standpipe)	Well elevation (top of standpipe)
epth to water table (from top of stand	pipe) Water table elevation
ngth of water column (LWC)	(feet)
- 4" diameter 1	gallons gallons gallons gallons gallons gallons gallons
PHYSICAL APPEARANCE AT START	
Color Clear Od	r Musty Turbidity None
Was an oil film or layer apparent?	-
PREPARATION OF WELL FOR SAMPLING	
Amount of water removed before sam	oling gallons
Did well go dry?	
. PHYSICAL APPEARANCE DURING SAMPLIN	
Color	Odor Turbidity
Was an oil film, or layer apparent	
. WELL SAMPLING	
Analysis	Bottle No. Special Sampling Instructions
•	
•	
• CONDUCTIVITY	
	PH
. COMMENTS	
No Flow, Stagnant W.	ter



Client NAVFAC			Job No. C	
Sample Location Naval Ex	change Gas Stati	600	Well No. <u>CB-18</u>	
Sampled By Mark A. Ro	andu 230 Date	e <u>/2//5/8</u>	39 Time	
Weather Sunny	_ Sam	pled with Ba	iler Pump	المراجعة والأجاد
A. WATER TABLE				
Well depth (from top of stand	ipipe) Well ele	vation (top	of standpipe)	
Depth to water table (from to	op of standpipe)	Water tab	le elevation	
Length of water column (LWC)	(feet)			
Volume of water in well - 2" - 4" - 6"	diameter wells = 0.163 x diameter wells = 0.653 x diameter wells + 1.469 x	(LWC) =	gal	lons
B. PHYSICAL APPEARANCE AT ST	TART			
Color Clear/Grange Bro	wa Odor Mosty		Turbidity Now	<u>_</u>
Was an oil film or layer	, 7			
PREPARATION OF WELL FOR	SAMPLING			
Amount of water removed 1	pefore sampling	gallo	ns	
Did well go dry?				
D. PHYSICAL APPEARANCE DURIN	NG SAMPLING			
Color	Odor		Turbidity	
Was an oil film, or layer	r apparent?			
E. WELL SAMPLING				
Analysis	Bottle No.	Specia	1 Sampling Instruct	ions
2.				
3.	1			
CONDUCTIVITY				
			PH	
G. COMMENTS				
No Flow Stag Na	17 Water			



	AVFAC		Job No	
ample Location	Naval Exch	range Gas Start	<u>'⊙∧</u> Well No	CB-4
		Zanda Z. Zo Date	•	•
eather	SUNNY	Sample	ed with Bailer	Pump
WATER TABLE				
ell depth (from	top of standpipe	e) Well elevat	ion (top of standpi	.pe)
epth to water to	able (from top of	f standpipe)	Water table elevati	.on
ength of water	column (LWC)	(feet)		
lume of water	- 4" diar	meter wells = 0.163 x (I meter wells = 0.653 x (I meter wells + 1.469 x (I	.WC) =	gallons gallons gallons
. PHYSICAL APP	EARANCE AT START			
Color	ileat	Odor Mosty	Turbidit	y Slight
Was an oil f	ilm or layer appa	arent? No	-	V
PREPARATION (OF WELL FOR SAMPI	LING		
Amount of war	ter removed befor	re sampling	gallons	
Did well go	dry?			
- PHYSICAL APP	EARANCE DURING SA	AMPLING		
Color		Odor	Turbid	ity
Was an oil f	ilm, or layer app	parent?		
. WELL SAMPLIN	<u>G</u>			
Analys:	<u>is</u>	Bottle No.	Special Sampling	Instructions
•			<u> </u>	
CONDUCTIVITY				



Client	NAUFAC			Job No.	
Sample Location	on Naval Ex	change Gas	s Station	<u> Nell No.</u>	CB-5
Sampled By	Mark A. R	andazzo_	Date	15/89	Time
Weather	Sunny		Sampled wi	ith Bailer	Pump
MATER TAB	-				
Well depth (f:	rom top of standp	oipe)We	11 elevation	(top of stand)	pipe)
Depth to wate:	r table (from top	o of standpipe)	Wate	er table eleva	tion
ength of wate	er column (LWC) _	(feet)			
Olume of wate	- 4" d	liameter wells = 0 liameter wells = 0 liameter wells + 1	$.653 \times (LWC)$	*	gallons
B. PHYSICAL	APPEARANCE AT STA	ART			
Color	lear	Odor	usty	Turbid	ity None
Was an oi	l film or layer a	ipparent? <u>Sh</u>	een		
C. PREPARATI	ON OF WELL FOR SA	AMPLING			
Amount of	water removed be	efore sampling		gallons	
Did well	go dry?				
D. PHYSICAL	APPEARANCE DURING	S SAMPLING			
Color		Odor		Turb	idity
Was an oi	l film, or layer	apparent?			
E. WELL SAMP	LING				
Ana	<u>lysis</u>	Bottl	e No.	Special Sampli	ng Instructions
1.					
3.					
5.					
F. CONDUCTIV	<u>ITY</u>				•
					_ PH
G. COMMENTS					
Stead	y Flow, Co	evolutions	Sheen:	Flowing	from
discha	rge pipe			J	



Client	NAVFAC		Job No	
Sample Location	on Markel Ex	change Gas S	ration Well No. CB-	7_
		_ 11 1	Date 12/15/89 Time	
			Sampled with Bailer Pump	
A. WATER TAB				
Well depth (f	— rom top of stand	pipe) Well e	elevation (top of standpipe)	
			Water table elevation	
		(feet)		
Volume of wat	- 4"	diameter wells = 0.163 diameter wells = 0.653 diameter wells + 1.469	3 x (LWC) = g	allo allo allo
B. PHYSICAL	APPEARANCE AT ST	ART		
Color	Tleat	Odor	ty Turbidity No.	ve
Was an oi	l film or layer	apparent? No	7	
C. PREPARATI	ON OF WELL FOR S	SAMPLING		
Amount of	water removed b	pefore sampling	gallons	
Did well	go dry?			
D. PHYSICAL	APPEARANCE DURIN	IG SAMPLING		•
Color		Odor	Turbidity	
Was an oi	1 film, or layer	apparent?		
E. WELL SAMP				
Ana	lysis	Bottle No	Special Sampling Instru	ctio
1.	•			
2.	•			
4.				
F. CONDUCTIV	TTV			
r. CONDUCTIV	111		Dr.	
	·		PH	
G. COMMENTS	-11	, , , ,		
- Care	, 51 0N	grade while	waiting for gas pump	
	p bostes	seen in basin)	

APPENDIX D

SOIL BORING LOGS/WELL INSTALLATION DIAGRAMS

Report of Boring No. Sheet I of 1 O'BRIEN & SERE TEST BORING LOG ENGINEERS, INC. Date SAMPLER Ground Water Depth Project Location: Groton, Connecticut Type: Hollow Stem Auger Hammer: #140 Depth Date Fall: 30" File No.: 1862.023 Client: U.S. Department of the Navy Boring Location: Under Canopy/Near Island #2 Ground Elevation: Boring Co.: East Coast Drilling & Boring Company Foreman: Rick Berhand Ended: 12/12/89 Dates: Started: 12/6/89 OBG Geologist: MARK RANDAZZO Field Testing Stratum Sample Change Equipment Sample Installed So "N" Description General Depth Blows Penetr/ TIP ρН Cond 5# /6" Descript Depth Valve Recovry No CONCRETE 128 8*-36* Hand Excavated Dark Brown, Moist, Fine to Med. Sand/some fine gravel & silt, Occassional chunks of concrete & asphalt, No Odors or Staining Petroleum Odors Noticed at 27" 256 31 31-51 3-4-2-2 24"/6" 6 Light Bray-White, Loose, Moist, Fine Sand-3'6" silt, Moderate Odors- - - - -Dark Brown, Loose, Moist, Fine to Medium Sand/some fine gravel, silt, and asphalt. 416" Light Gray, Damp, Fine Sand - CS Silt, Petroleum Odors present 96 24"/4" PUSH 5' -7' 6'6" 565 24"/4" Brown/Tan, Damp, Fine Gravel/some fine 7١ 71-91 PUSH silt - medium sand- - - - - - - -Light Gray, Damp, Fine Sand - CS Silt, Strong Petroleum Odors 228 24"/4" 5 91 91-111 3-3-2-3 5 Brown/Tan, Wet, Soft, Fine Bravel-CS Sand/ trace fine sand & silt, Strong Petroleum Odors, Black product noticed in spoon 189 24"/4" 111'-13' PUSH 24"/0" No Sample PUSH 13' -15' 71 -FILL-15'-17' 6-3-3-11 24"/6" 6 -16' Brown/Tan, Wet, Soft, V.Fine Sand/Silt, Odors Present, Natural Material (8') PORTLAND CEMENT (1 BAG)

WELL MATERIALS: 2" PVC/0.020 SLOT SCREEN (B') 2" PVC RISER (6')

LOCKING FLUSH MOUNTED BOX # 00 DOUBLE WASHED SAND (4 BAGS) MASTER LOCK DENTANTE DELLETS (1 PAIL)

REMARKS: SCREENED POSITIONED FROM 61-141 PUSH: Hammer not used - hieght restraints

Report of Boring No. Sheet 1 of 1 ODG-2 O'BRIEN & BERE TEST BORING LOG ENGINEERS, INC. SAMPLER Project Location: Groton, Connecticut **Ground Water Depth** Date Type: Hollow Stem Auger Depth Date Fall: 30" Client: U.S. Department of the Navy Hammer: #140 File No.: 1862.023 Boring Location: South of Island #3 Ground Elevation: Boring Co.: East Coast Drilling & Boring Company Foreman: Jimmy Cutler OBS Seologist: MARK RANDAZZO Dates: Started: 12/8/89 Ended: 12/12/89 Field Testing Sample Stratum Sample Equipment Change Depth Penetr/ *N* Description General Installed Sp Blows /6* рH Depth Valve Descript Cond TIP Sŧ Recovry No CONCRETE 22 6* 6"-36" Hand Excavated Dark Brown, Moist, Fine to Med. Sand/some fine gravel & silt, No Odors or Staining 31-51 24"/18" 15 5-6-5-3 11 316" Light Gray, Damp, Loose, Fine Sand-Silt, Slight Petroleum Odor 416 Brown, Damp, Loose, Fine to Medium Sand/ some cs sand/trace silt & fine gravel 5'-7' 24"/4" 32 2-2-2-3 4 71-91 66 24"/18" 6 2-4-2-3 8 Tan/Brown, Moist to Wet, Loose, Very CS Sand/some fine sand/trace silt, slight 91 5 9'-11' 2-1-1-2 24"/6" 2 petroleum odor 120 Brown/Tan, Wet, Soft, Fine Gravel-CS Sand/ trace fine sand & silt, Strong Petroleum Odors, Black product noticed in spoon 125 11'-13' 2-2-2-4 24"/4" 4 131 Dark Gray, Wet, Loose, Fine to Med. Sand/ some very cs sand No Sample 66 24"/4" 13' -15' 5-5-5-5 4

WELL MATERIALS: 2" PVC/0.010 SLOT SCREEN (10')

2-1-2-6

15' -17'

16.5

-FILL-

2" PVC RISER (7") # 00 DOUBLE WASHED SAND (4 BAGS) BENTONITE PELLETS (1 PAIL)

24"/4"

3

LOCKING FLUSH MOUNTED BOX MASTER LOCK

REMARKS: SCREENED POSITIONED FROM 7'-17'

57

		GERE S, INC.				TEST B	ORING LOG	Repoi	rt of Boring Sheet 1	No. (DB C -3		
ľ			Groton, (SA Type: Hollow Stem Hammer: #140	MPLER Auger Fall: 30"	Ground Wate	Depth	Da Da			-
Boring Forema OBS Ge	Co. n: olo	.: East (Jimmy Cut gist: MAR	Coast Dril: ler K RANDAZZO	ling & Bo	ring Co	mpany	Boring Location: West Ground Elevation: Dates: Started: 12/13				Ended:	12/13	/89
			Sample	***************************************		Co	mple	Stratum Change	Equipment	Fie	ld Tes	ting	R
Depth	No	Depth	Blows /6"	Penetr/ Recovry	"N" Valve	Desc	ription	General Descript	Installed	рН	Sp Cond	TIP	k
3"-4"							HALT————————————————————————————————————						Γ
	1	6"-36"	Hand Exc	avated		Sand/some cs gravel Dark Brown, Moist,	and sand/trace silt Fine to Med. Sand/some					0.0	
	\vdash					Time gravei & Siit,	No Odors or Staining						
	2	31-51	2-2-3-4	24*/18*	5	Brown, Dawn, Loose,	Fine to Medium Sand/					0.3	
						trace cs sand, No O	dors or Staining						
	3	51-71	3-4-6-5	24"/18"	10							0.1	
5'6"	-		3 7 0 0		10							"	
			·			Dark Brown, Damp, C Sand/some coarse gr No Odors or Stainin	Compact, Fine to Medium avel & sand/trace silt						
	4	71 -91	1-4-3-3	24"/0"	-	No Sample						0.1	
	F												
	5	9'-11'	2-1-1-1	24*/8*	2							0.1	
9'6"	-					Dark Black, Wet, Lo	ose, CS Silt-V.Fine						
						Staining	present, No Odors or						
	6	11'-13'	2-2-2-4	24"/6"	4							0.1	
121													
131	7	13'-15'	1-5-8-12	24*/6*	13	Light Black, Wet, L silt/some medium sa gravel, No Odors on	loose, Fine Sand to Fine and/trace cs sand-fine Staining					0.1	
	<u> </u>					{	ed. Dense, Fine Sand- avel, well sorted	•					
-	-				-		,						
	В	15' -17'	6-7-7-11	24"/6"	14							0.1	
1		1	ł	1				1		1	1		

WELL MATERIALS: 2" PVC/0.010 SLOT SCREEN (10')
2" PVC RISER (7')
\$ 00 DOUBLE WASHED SAND (4 BAGS)
BENTONITE PELLETS (1 PAIL)

PORTLAND CEMENT (1 BAG) LOCKING FLUSH MOUNTED BOX MASTER LOCK

REMARKS: SCREENED POSITIONED FROM 7'-17'

		GERE S, INC.				TEST B	DRING LOG	Repor	t of Boring Sheet I	No. (DBG-4		
•			Groton, I			SA Type: Hollow Stem Hammer: #140	MPLER Auger Fall: 30"	Ground Wate	Deoth	Dai Dai	-		
Boring Foreman	Co.	: East (Rick Berl	Coast Dril	ling & Bo			Boring Location: Betw Bround Elevation: Dates: Started: 12/5/	een Island i			Ended:	12/5/	89
			Sample			e-	1-	Stratum Change	Equipment	Fie:	ld Tes	ting	1
Depth	No	Depth	Blows /6"	Penetr/ Recovry	"N" Valve		mple ription	General Descript	Installed	рH	Sp Cond	TIP	* K
6*							crete	•					
	1	6"-42"	Hand Exc	avated		Sand/trace es sand-	Compact, Medium to fine fine gravel-cobbles, of concrete & asphalt, or					140	
21								_					
3'6"	5	316"-51	*5-4-2-2	24"/12"	6	Light Brown, Moist, trace coarse gravel concrete, Petroleum	Fine to Medium Sand/ , occassional piece of Odors present		·			119	
						Light Gray White, I some silt/trace cs	loist, Loose, Fine Sand/ gravel						
PLEX	Ļ	5151 31	12.005	248/408	10							422	
5'6"	3	5, 6/,	6"3-8-8-5	24"/18"	10	i Sand/trace és sand-	Dense, Fine to Medium fine gravel-silt,	-				1	
	1	<u> </u>				Petroleum Odors Pro	esent						
¹ 7	1			0154045	ļ	-fILL_		-				171	
7'6"	4	7'6"-9'	6- PUSH	24"/24"	-	some fine sand/trac	Noist to Wet, Fine Silt.					"	
						Light Gray, Wet, Fr Petroleum Odors mod	ine Sand-CS Silt, derate to strong						
	5	9'6"-11	6*10-11-1	0-10 24"/	24" 21							2.6	
	6	11'6"-1	3'6" PUSH	24"/12"	-	Slight Petroleum O	dor, No Staining					4.8	
	1												
	+	-	 	1		1							
	7	13'6"-1	5'6" PUSH	24"/12"	1-	Slight Petroleum O	dor, Mo Staining					3.8	
16'	\downarrow							_					
	+				-								
	1									<u> </u>		<u> </u>	

WELL MATERIALS: 2" PVC/O.010 SLOT SCREEN (10')
2" PVC RISER (6')
\$ 00 DOUBLE WASHED SAND (4 BAGS)
BENTONITE PELLETS (1 PAIL)

PORTLAND CEMENT (1 BAS) LOCKING FLUSH MOUNTED BOX MASTER LOCK

REMARKS: SCREENED POSITIONED FROM 6'-16'

D'BRIEN & BERE ENGINEERS, INC. Report of Boring No. OB6-5 TEST BORING LOG Sheet I of 1 Project Location: Groton, Connecticut SAMPLER Ground Water Depth Date Type: Hollow Stem Auger Depth Date Client: U.S. Department of the Navy Hammer: #140 Fall: 30" File No.: 1862.023 Boring Co.: East Coast Drilling & Boring Company Foreman: Jimmy Cutler Boring Location: Tang Ave/South of Island #3 Ground Elevation: OB6 Geologist: MARK RANDAZZO Dates: Started: 12/14/89 Ended: 12/14/89 Sample Stratum Field Testino Sample Description Change Equipment Installed Deoth "N" Blows SD Penetr/ General Depth /6* Recovry |Valve Descript ρН Cond TIP 51 3"-4" ASPHALT-Dark Brown, Damp, Compact, Fine to Medium 16.8 11 16"-36" 1 Sand/some cs gravel and sand/trace silt Hand Excavated Dark Brown, Moist, Fine to Med. Sand/some fine gravel & silt, No Odors or Staining 21 2" of Asphalt— Light Gray, Damp, Fine to Medium Sand/ trace fine to very cs gravel, Well Sorted, Petroleum Odors Present, No Staining 6.0 24"/18" 31-51 3-4-4-7 Dark Brown, Damp, Loose, Fine Sand-CS Silt /little medium sand, Root System Present 2.3 15 24"/18" 414" 5' -7' 5-10-5-6 Green to Dark Green, Damp, Loose, Fine to Medium Sand/trace fine to cs silt 30.2 24"/18" 91 7"-9" 9-7-5-4 Tan/Brown, Wet, Med. Dense, Fine Sand- CS Silt/trace cs sand, Strong Petroleum Odors No Staining 6.8 9'-11' 1-1-3-5 24"/18" 4 3.5 18-17-19-14 24*/20 111'-13' 2.0 24"/14" 12 13'-15' 7-7-5-9 0.7

WELL MATERIALS: 2" PVC/0.010 SLDT SCREEN (10') 2" PVC RISER (8')

7-7-7-9

8

181

15' -17'

B. C. E.

00 DOUBLE WASHED SAND (4 BAGS) BENTONITE PELLETS (1 PAIL)

24"/18"

PORTLAND CEMENT (1 BAG) LOCKING FLUSH MOUNTED BOX MASTER LOCK

REMARKS: SCREENED POSITIONED FROM 8'-18'

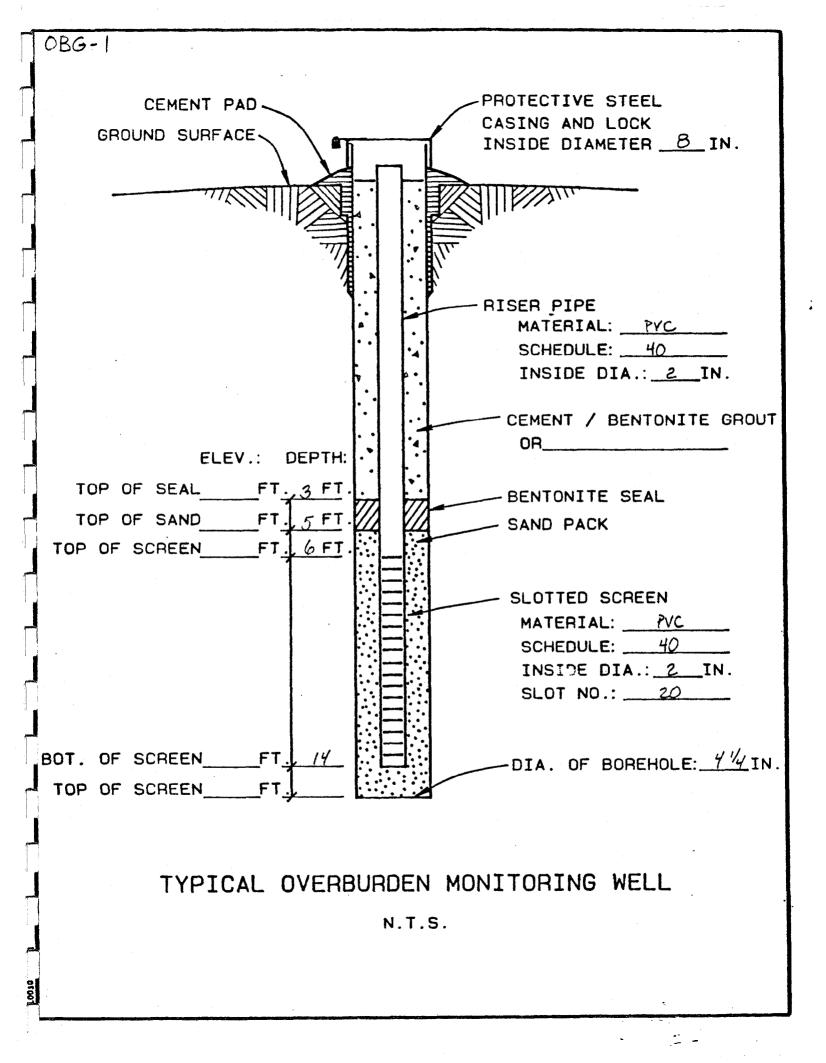
O' BRIE	ON (GERE S, INC.			-	TEST BORING LOG	Repor	t of Boring	No. [)BG-6		
			Groton, (Connection	ut.	SAMPLER	Ground Mate	Sneet 1 of 1 Ground Water Depth Date				
Ì			arocon, i ortment of			Type: Hollow Stem Auger Hammer: #140 Fall: 30"	File No.: 1	Depth	Dat			
Foresa	ո։ .	Jimmer Cut	Coast Dril ler K RANDAZZ	_	ring Co	Daring Location: Tang Ground Elevation: Dates: Started: 12/14		f Island #1		Ended:	12/14	/89
			Sample			C}-	Stratum	F	Fie	ld Tes	ting	R
Depth	No	Depth	Blows /6"	Penetr/ Recovry	"N" Valve	Sample Description	Change General Descript	Equipment Installed	рН	Sp Cond	TIP	k S#
3"-4"						ASPHALT Dark Brown, Damp, Compact, Fine to Medium						
·	1	6"-36"	Hand Exc	avated		Sand/some cs gravel and sand/trace silt Dark Brown, Moist, Fine to Med. Sand/some fine gravel & silt, No Odors or Staining					2.1	
51	5	31-416	2-7-22	18"/1"	29						-	
						Brown/Tan, Damp, Dense, Fine SAnd-CS Silt, Well Sorted, Petroleum Odors, No Staining						
			٠.									
·	3	5'-7'	5-8- 6-6	24"/18"	14	Petroleum Odors, No Staining					6.7	
	4	71-91	4-4-4-4	24*/18*	8	Petroleum Odors Present, No Staining					32.8	
	5	9'-11'	1-1-3-5	24"/18"	4	Petroleum Odors Present, No Staining					17.1	
						·						
10'6"	<u> </u>	<u> </u>					-[
10'9"	6	11'-13'	7-13-16-2	2 24"/18"	29	Dark Black Organic Mat Brown, Damp, Dense, Very Fine Sand-Silt/ some medium sand/trace fine gravel,					4.3	
						Petroleum Odors Present, No Staining						
	7	13'-15'	10-14-14-	1524"/18"	28	Slight Petroleum Odor, No Staining					0.7	,
	\vdash				-							
	В	15' -17'	14-16-22-	2324"/18"	38	Slight Petroleum Odor, No Staining					0.4	-
17'		B. O. E.		1	1		-[1		1	

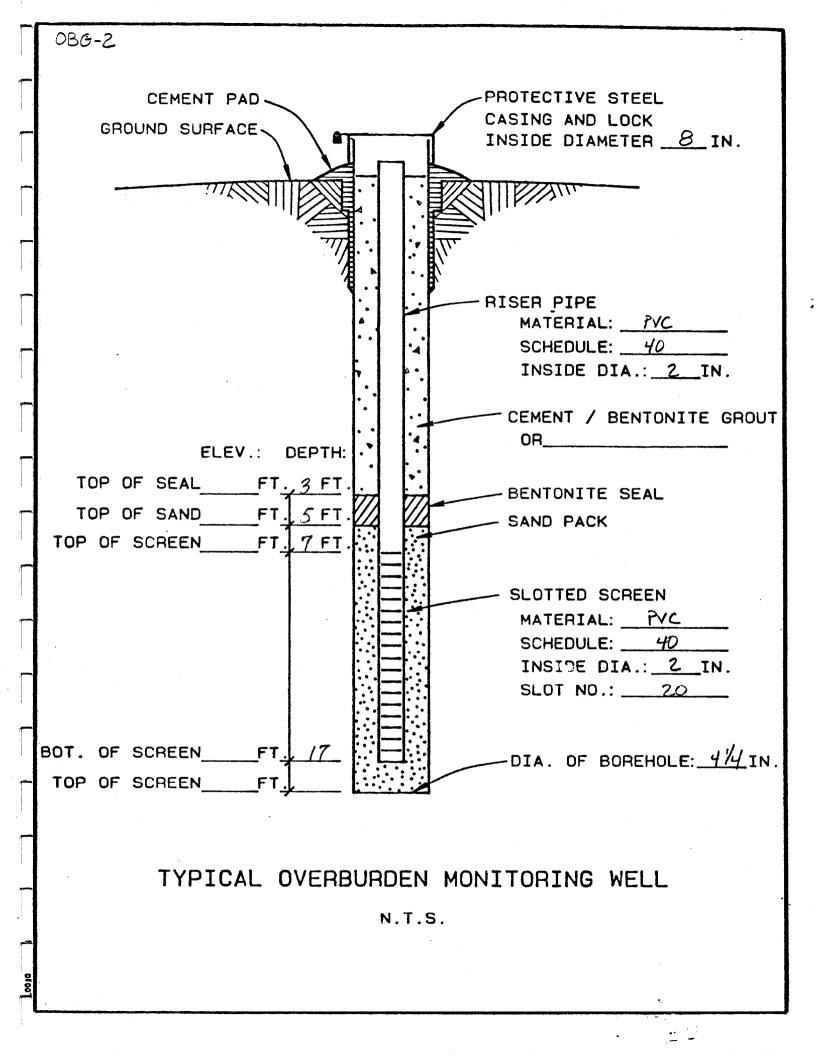
MELL MATERIALS: 2" PVC/0.010 SLOT SCREEN (10") 2" PVC RISER (7") # 00 DOUBLE WASHED SAND (4 BAGS) BENTONITE PELLETS (1 PAIL) PORTLAND CEMENT (1 BAG) LOCKING FLUSH MOUNTED BOX MASTER LOCK REMARKS: SCREENED POSITIONED FROM 71-171

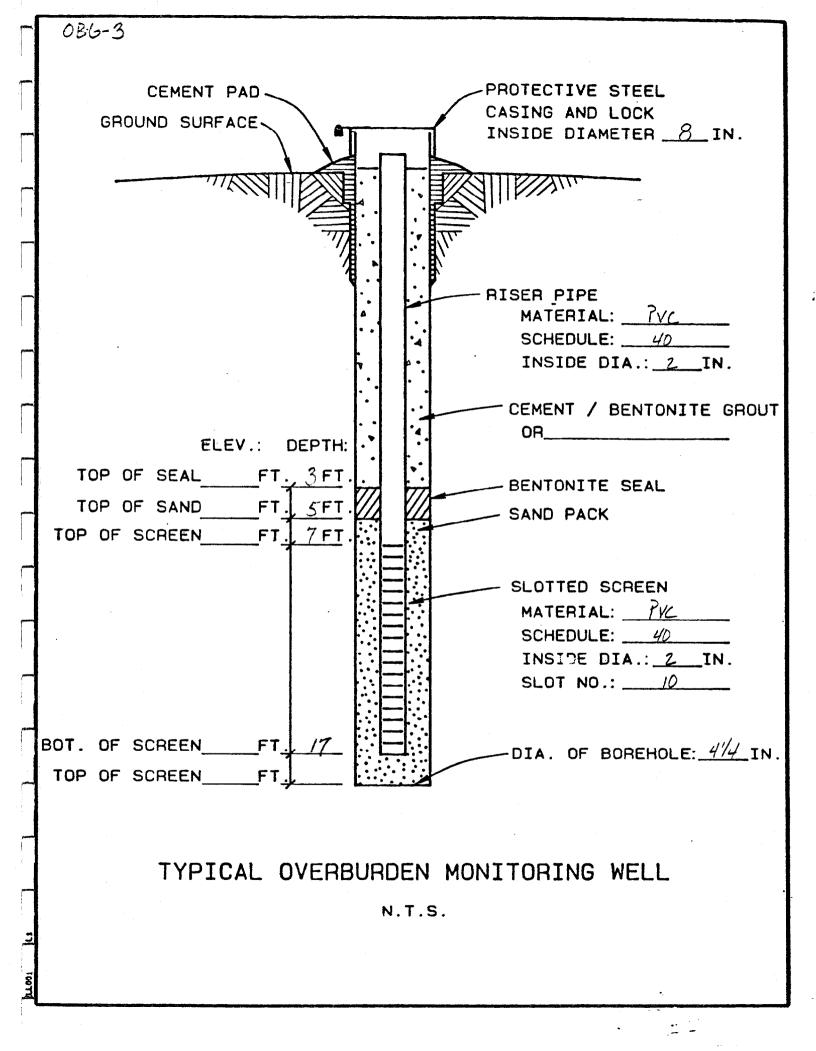
DEINEERS, INC. DEPTH 8' MW-7 DATE 6:26 ELEV. PROJECT LOCATION: GROTON, CONN. SAMPLER TYPE: SPLIT SPOON CLIENT: NAVFAC . HAMERI 140 FILE NO. : FALL: 30 BORING LOCATION: NAVAL GAS STATION SORING DL: EAST COAST DRILLING GROUND ELEVATION: PREMI BRETT SWIATEK DB6 SEDLOGIST: FJ. FERREIRA **EOED:** 6126190 DATES: STARTED: 6 126190 FIELD TESTING SWPLE EDUIPMENT INSTALLED SAMPLE DESCRIPTION STRIUM SP. CCVO. CHAVEE DEPTH ואדעפס BLOWS PENETRAL 0/00 HNU S DEPTH 16. REDDVERY VALLE MACADAM < 1 BROWN, DRY MED. DENSE F-M SAND 211/12 8.7.9.10 SOME F-M GRAVEL, TR COBBLES BROWN, DRY, VERY DENSE, E-M GRAV. <1 SOME LG COBBLES 25-45 100/.5 BROWN, DRY, F-M SAND, TR. F-M 24//2" 41 4.5-6.5 14.12.27.42 20. GRAVEL, TR. SILT, TR. COBBLES BROWN WET, LOOSE, F-M SAND, TR SILT, TR FO 24"/24 4 7-9 5277 GRAYEL 8 GRAY-BROWN, WET, MED. DENSE, F-M <1 24"/12" 1.1.13.15 SAND, SOME SILT 9 BROWN, WET, DENSE, M-C SAND, TR. 24"/10 41 SILT 125 BROWN, WET, MED. DENSE, M-C SAND, 24"/12 41 4.3.19.17 TR. SILT

DEINEDS, INC. SROUND MATER DEPTH &' DEPTH MW-8 DATE 6.25.90 BLEV. PROJECT LOCATION: GROTON, CONN. SWPLER TYPE: SPLIT SPOON CLIDIT: NAYFAC 30" FILE NO. 1 FALL BORING LOCATION: GROUND ELEVATION: SORING COL: EAST COAST DRILLING BRETT SWIATEK DE SELLEISTE F.J. FERREIRA EOED: 6 125790 DATES: STARTED: 6 125190 FIELD TESTING R SWIFLE EDUIPMENT INSTALLED SAMPLE SP. SPL. "N» DESCRIPTION CHNE PENETROV DEPTH BLOWS DEPTH 0/00 HNU DEPTH REDDMERY VALUE <1 BROWN, DRY, DENSE, F-M SAND, 24 1/12 . 38 0-2.5 17.19.19.21 TR F-M GRAVEL BROWN, DRY, MED. DENSE, F-M SAND, 4 24"/18" 2.5-4.5 9.7.7.7 TR. F-M GRAVEL 14 LT. BLACK - BROWN, DAMP, DENSE, F-M 24% <1 4.5-6.5 9.13.23.24 36 SAND, TR. F-M GRAVEL 6.5 BROWN-GRAY, MOIST, VERY DENSE, 24"/12" ۷١ F-M SAND, TR. COBBLES 65-85124.32.22-11 54 BROWN, WET, LOOSE, PEAT, ROOTS, <1 5 8.5-10 4.3.2 WOOD (FILL) 9.5 GRAY-BROWN, WET, LOOSE, M-C SAND 24"/18 <1 10-12 10.2.4.6 6 TR. F-M GRAVEL 11.5 GRAY-BROWN, WET, MED. DENSE, M-C SAND, TR. F-M GRAVEL 24"/12" ۷ ۱ 12-14 7.10.18.25 28 #1 24"/12" 21 14-16 2.7.14.16 11

DEINEERS, INC. GROUND WATER DEPTH DEPTH MW-9 MIE BEV. PROJECT LOCATION: GROTON, CONN. SAMPLER SPLIT SPOON HAMER: 140 # CLIENT: NAVFAC FILE NO.: FALL: 30" NORING CO. 1 FOREIGN1 BORING LOCATIONS EAST COAST DRILLING GRUND ELEVATION: DATES: STARTED: 6 126190 BRETT SWIATEK OBE SEDLOGIST: F.J. EOED: 6126190 FIELD TESTING IR SWALE STRIUM CHREE DEPTH EDUIDMENT SAMPLE SP. INSTALLED HAU S BLOWS /6* PENETRAV REDUVERY HTEED DESCRIPTION 0/00 VALUE DEPTH No. BROWN, DRY, MED. DENSE, F-M SAND, 24 1/18" 0-2' <1 7-15-7-20 TR. F-M GRAVEL DK. BROWN, MOIST, MED. DENSE, F-M 24 1/12. 2-4" 23.11.8.9 19 30 SAND, TR. SILT, TR. ROUTS, FUEL ODOR GREEN-BROWN, MOIST, DENSE, F-M SAND, 24"/6" 70 37 4-6 13.15.22.17 TR. GRAVEL, TR LARGE COBBLES GREEN-BROWN, MOIST, MED. DENSE, 600 19.7.9.5 F-MSAND, TR. GRAVEL, TR. COBBLES 24"/18" 590 3.9.12.11 8-10 ORANGE-BROWN, WET, MED. DENSE 300 24"/18" 2.3.6.16 F-C SAVD 11 125 12-14 20 5.10.10.2

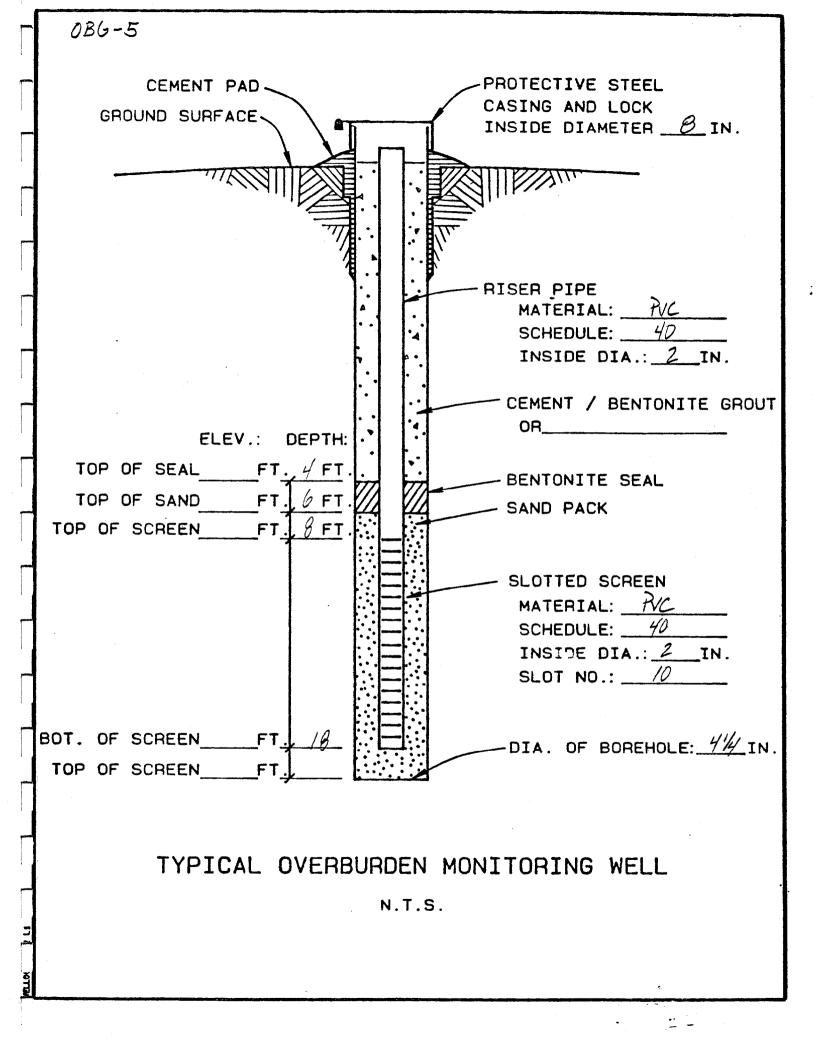


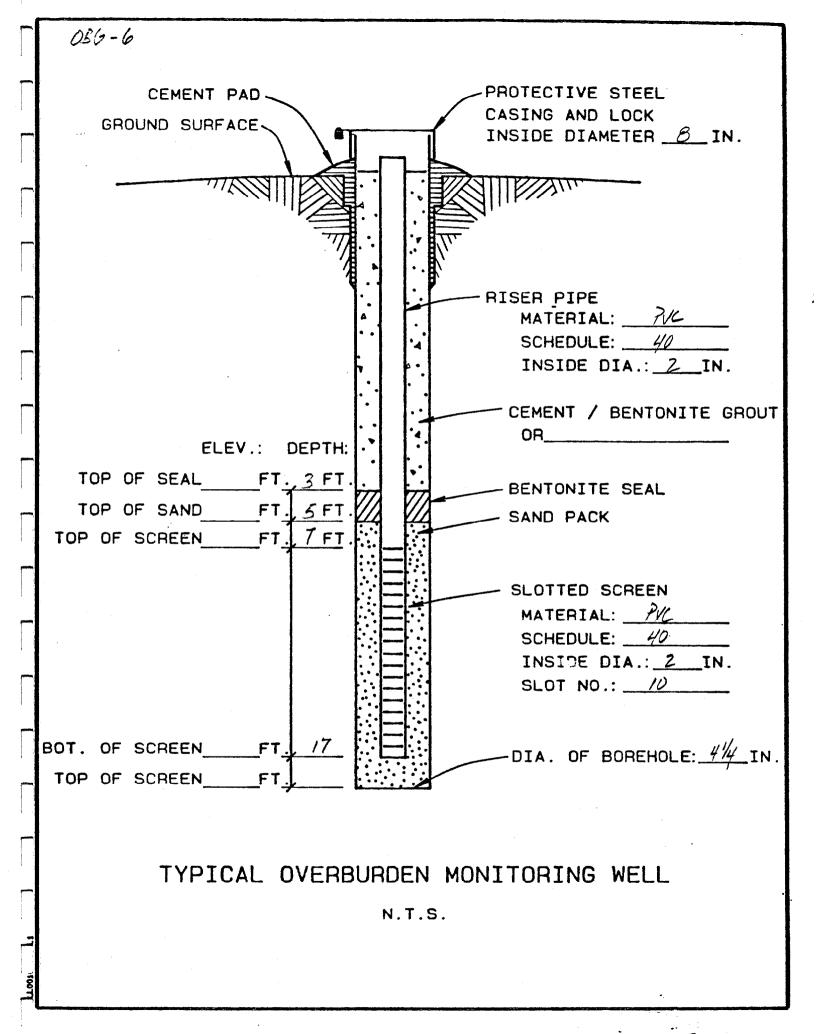


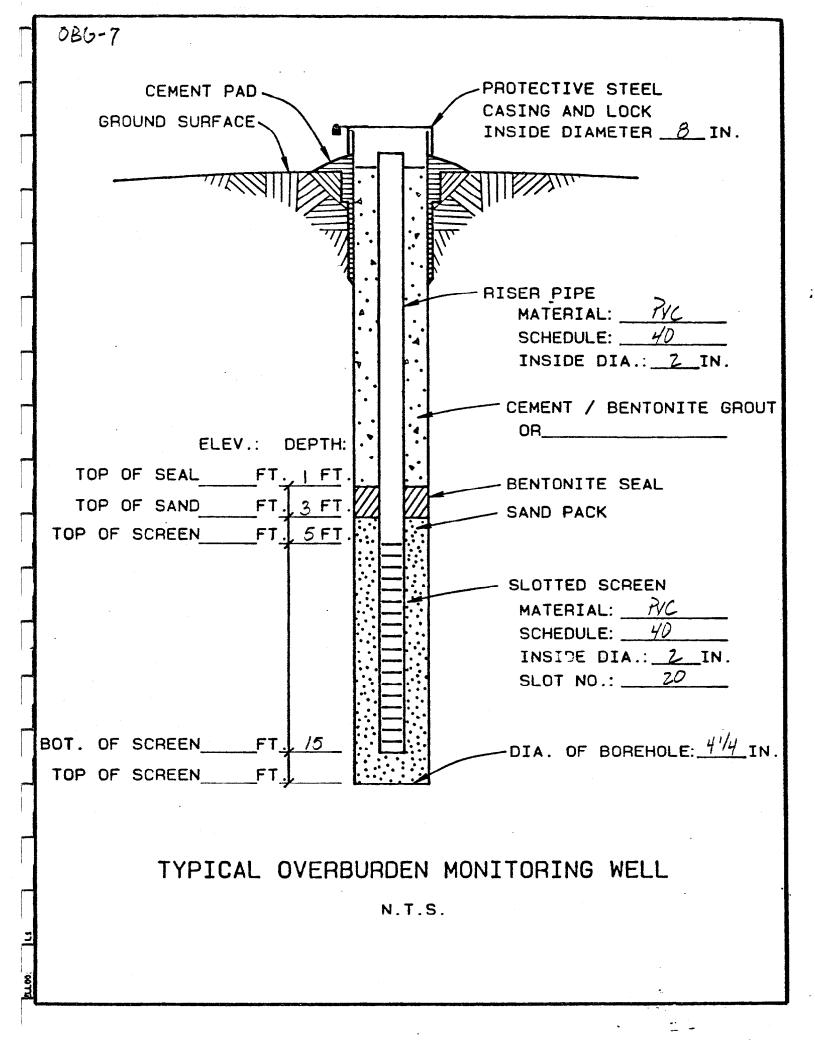


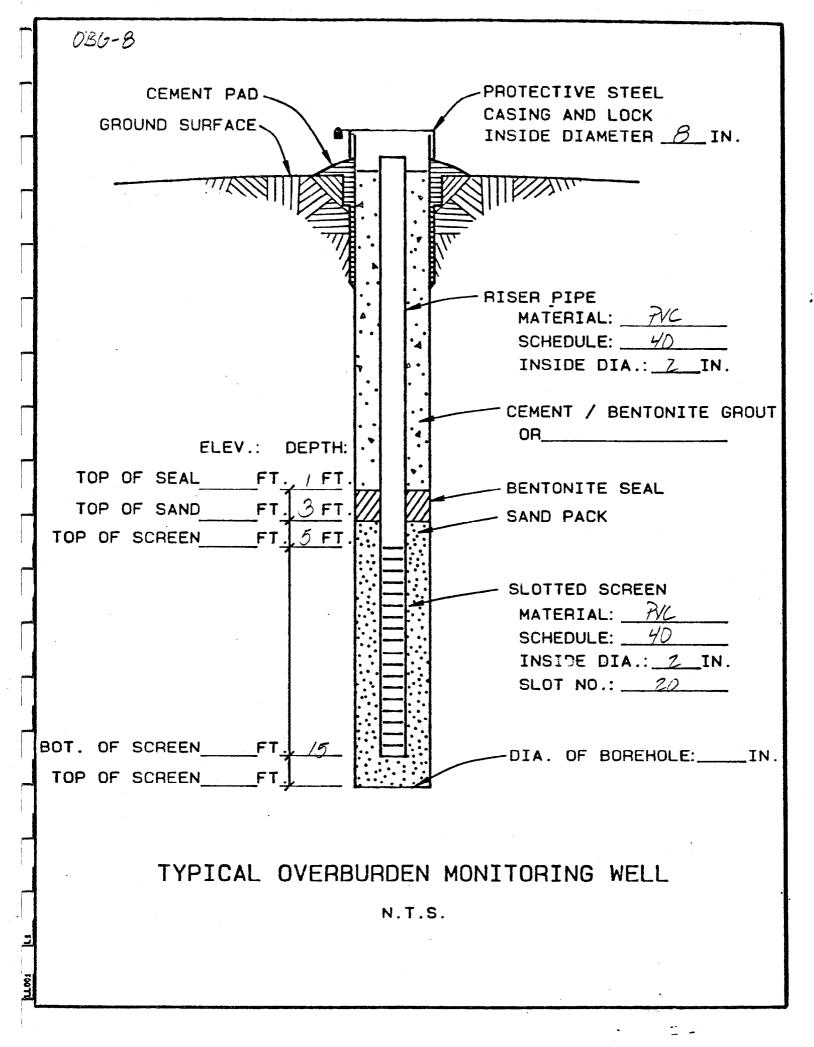
	0BG-4
	CEMENT PAD PROTECTIVE STEEL CASING AND LOCK INSIDE DIAMETER IN.
	RISER PIPE MATERIAL: PVC SCHEDULE: 40 INSIDE DIA.: 2 IN.
	CEMENT / BENTONITE GROUT OR TOP OF SEALFT./.5FT. TOP OF SANDFT. 4FT. SAND PACK
	TOP OF SCREEN FT. 6FT. SLOTTED SCREEN MATERIAL: PVC
	SCHEDULE: 40 INSIDE DIA.: 2 IN. SLOT NO.: 20
	BOT. OF SCREENFT/6DIA. OF BOREHOLE: 41/4/IN.
1.1	TYPICAL OVERBURDEN MONITORING WELL N.T.S.
1100	·

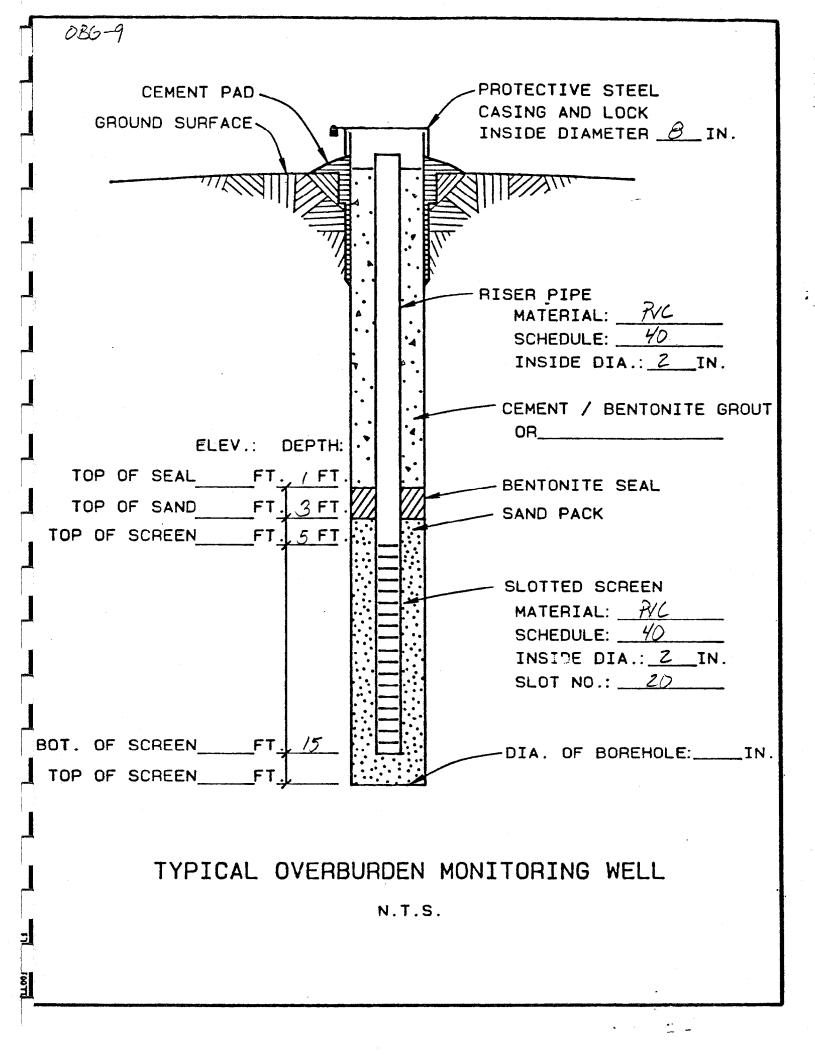
· :-











APPENDIX E GROUND WATER SAMPLING FIELD LOGS

Şamp	le Location Naval Exchange Gas Station Well No. OBG-1
••	led By Mark A. Randa 770 Date 12/15/89 Time 11:20
	her Sonny Sampled with Bailer Pump
	Water Table
Well	depth (from top of standpipe) /6 Well elevation (top of standpipe)
Dept	h to water table (from top of standpipe 9.00 Water table elevation
Leng	th of water column (LWC) 7.0 (feet)
Volu	mme of water in well - 2" diameter wells = $0.163 \times (LWC) = 1.14$ gallons - 4" diameter wells = $0.653 \times (LWC) = 1.14$ gallons - 6" diameter wells = $1.469 \times (LWC) = 1.14$
B.	Physical Appearance At Start
	Color Brown Odor Strong Petroleum Turbidity Maderate
	Was an oil film or layer apparent? Yes 18"
c.	Preparation of Well for Sampling
	Amount of water removed before sampling 3.42 gallons
•	. Did well go dry? No
D.	Physical Appearance During Sampling
	Color Dark Brown Odor Strong Turbidity Heavy
	Was an oil film or layer apparent? <u>Yes 78</u>
E.	Well Sampling
	Analysis Sottle No. Special Sampling Instructions
$\frac{1}{2}$.	
2. 3. 4.	
<u>5.</u> 6.	
7.	
9. 10.	
F.,	Conductivity 0.45 Majon pH 5.75
G.	Dissolved Oz Content 3.50 mg/l

	Samp	le Location Noval Exchange Gas Station Well No. 086-2
parito.	amp	1ed By Mark A. Randa 220 Date 12/15/89 Time 12:30
	Weat	her Sonny · Sampled with Bailer Pump
	A.	Water Table
-	Well	depth (from top of standpipe) 17.0 Well elevation (top of standpipe)
	Dept	h to water table (from top of standpipe 9.0 Water table elevation
	Leng	th of water column (LWC) 8.0 (feet)
	Volu	me of water in well - 2" diameter wells = $0.163 \times (LWC) = 1.304$ gallons - 4" diameter wells = $0.653 \times (LWC) = 1.469 \times (LWC$
	B.	Physical Appearance At Start
		Color Brown (Greenish Brown) Odor Strong Petroleum Turbidity Very Turbid Was an oil film or layer apparent? Yes 2"
_	c.	Preparation of Well for Sampling
		Amount of water removed before sampling 3.91 gallons .
provide.		Did well go dry? No
	D.	Physical Appearance During Sampling
1		Color Dark Brown Odor Strong Actroleum Turbidity Very Turbid
prose.		Was an oil film or layer apparent? Yes
, ,	E.	Well Sampling
l Samer		Analysis Sottle No. Special Sampling Instructions
Incompany	1. 2.	·
ento-fin	3.	
i i	<u>5.</u> 6.	
-	7.	
`	5. 6. 7. 8. 9. 10.	
2	F.	Conductivity 0.44 us/cm pH 5.80
şdilmin,	G.	Dissolved Oz Content 2.6 mg/l

	Şamp	le Location Noval Exchange Gas Station Well No. 086-3
i.	Samb	led By Matk A. Randazzo Date 12/18/89 Time 1:10
manufat	Weat	her Sampled with Bailer Pump
		Water Table
	Well	depth (from top of standpipe) 17.0 Well elevation (top of standpipe)
	Dept	h to water table (from top of standpipe 9.44 Water table elevation
	Leng	th of water column (LWC) 7.56 (feet)
etimo,	Volu	me of water in well - 2" diameter wells = $0.163 \times (LWC) = \frac{1/23}{4}$ gallons - 4" diameter wells = $0.653 \times (LWC) = \frac{1/23}{2}$ gallons - 6" diameter wells = $1.469 \times (LWC) = \frac{1/23}{2}$
	B.	Physical Appearance At Start
		Color Clear Odor None Turbidity Very Slight
		Was an oil film or layer apparent? No
	c.	Preparation of Well for Sampling
-		Amount of water removed before sampling 3.70 gallons
		Did well go dry? Yes
	D.	Physical Appearance During Sampling
(Minds		color Brown Odor Musty Turbidity Maderate
		Was an oil film or layer apparent? No
-	ε.	Well Sampling
		Analysis Sottle No. Special Sampling Instructions
	1.	
painted.	<u>2.</u> 3.	
	4.	
	5. 6 .	
-	5. 6. 7.	
: • • •	<u>8.</u>	
-	8. 9. 10.	
:	F.	Conductivity 0.35 us/cm pH 6.85
	G.	Dissolved O, Content 8,50 mall

	Samp	le Location Noval Exchange Gas Station Well No. OBG-4						
_^	amp	led By Mark A. Randazzo Date 12/15/89 Time 10:15						
		her Sampled with Bailer Pump						
ganti -s		Water Table						
	Well	depth (from top of standpipe) 16.0 Well elevation (top of standpipe)						
Depth to water table (from top of standpipe 8.82 Water table elevation								
	Leng	th of water column (LWC) $\frac{7.18}{}$ (feet)						
	Volu	me of water in well - 2" diameter wells = $0.163 \times (LWC) = \frac{1.7}{2}$ gallons - 4" diameter wells = $0.653 \times (LWC) = \frac{1.7}{2}$ gallons - 6" diameter wells = $1.469 \times (LWC) = \frac{1.7}{2}$						
parin.	B.	Physical Appearance At Start						
ramen.		color Very light Brown Odor None Turbidity Slight						
		Was an oil film or layer apparent? No						
ſ	c.	Preparation of Well for Sampling						
		Amount of water removed before sampling 3.51 gallons .						
	•	Did well go dry? No						
	D.	Physical Appearance During Sampling						
]		color light Brown Odor None Turbidity Slight						
		Was an oil film or layer apparent? No						
	Ε.	Well Sampling						
!		Analysis Sottle No. Special Sampling Instructions						
	<u>1.</u> 2.							
٠	3.							
1	2. 3. 4. 5. 6. 7. 8. 9.							
	<u>8.</u>							
	F. .	Conductivity 0.37 ma/cm pH 5.45 Dissolved O2 Content 3.5 mg/l						
	G.	Dissolved Oz Content 3.5 mg/l						
		\mathcal{O}^{+}						

	Şamp	le Location Naval Ex	bringe Gas 5	station Well No	086-5
r-A	Jamp	led By Mark A. R	andazzo	Date 12/18/89	Time 4:30
patricus .	Weat	her <u>Sunny</u>		_ Sampled with Baile	r <u> </u>
	A.	Water Table		. 	•
	Well	depth (from top of stand	pipe) <u>18</u> We	11 elevation (top of	standpipe)
	Dept	h to water table (from to	p of standpipe <u>9</u> .	15 Water table ele	vation
	Leng	th of water column (LWC)	8.85 (feet)	ameter wells = 0.163 x (LWC) = /44 gallons ameter wells = 0.653 x (LWC) = gallons ameter wells = 1.469 x (LWC) = gallons of the sampling of th	
	Volu				
	B.	Physical Appearance At S	tart		4.
		Color <u>Clear</u>	Odor Slight	Petroleum Turbidity	None
		Was an oil film or layer	apparent?	No	
	c.	Preparation of Well for	Sampling	•	
		Amount of water removed	before sampling	<u>4.32</u> gallons	
,		Did well go dry? No			
ش	D. '	Physical Appearance Duri	no Sampling		
patrice.					Moderate
, ;		Was an oil film or layer	apparent? No		
<u></u>	Ε.	Well Sampling		÷	
		Analysis	Sottle No.	Special Sampli	ne Instructions
	1. 2.				
	3.				
	<u>5.</u> 6.				
	<u>7.</u> 8.				
	9. 10.				
	F.	Conductivity	92 Majem	pH	15
	G.	Dissolved Oz Content	•		

Samp	le Location N_{ab}	ial Excha	nge Gas Sto	tion Well	No OR	6-6
Jamp	led By Mark	LA. Ra	ndazzo	_ Date _12//8	189 Time	12:45
Weat	her Son	14 .		Sampled with	Bailer ν	Pump
A.	Water Table)	e			•
Well	depth (from top	of standpi	pe) <u>/7</u> We	ell elevation (t	op of standp	ipe)
Dept	h to water table	(from top	of standpipe 8 ,	93 Water tab	ole elevation	
Leng	Color Clear Odor Strong Petroleum Turbidity None. Was an oil film or layer apparent? Sheen Preparation of Well for Sampling Amount of water removed before sampling 3.95 gallons Did well go dry? No Physical Appearance Durino Sampling Color Datk Odor Strong Petroleum Turbidity Very Turbid Was an oil film or layer apparent? No Well Sampling Analysis Sottle No. Special Sampling Instructions					
Volu	me of water in we	- 4" di	ameter wells = ($).653 \times (LWC) =$		gallon
В.	Physical Appears	ince At Sta	rt		4.	
	color Clear		Odor Strong	Patroleum Turb	oidity No	we_
	Was an oil film	or layer a	pparent? <u>She</u>	en		-
:	Preparation of Well for Sampling					
	Amount of water	removed be	fore sampling _	<i>3.95</i> 9	allons .	
	Did well go dry?	· Ne)			
D.	Physical Appeara	ince Durino	Sampling			
	color Dat	<u>γ</u>	Odor Strong	1 Petroleum Turb	oidity Very	Turbid
	Was an oil film	or layer a	pparent? N	<u> </u>	9	
E.	Well Sampling					
	<u>Analysis</u>		Sottle No.	Special	Sampling In:	structions
1.		1				
1. 2. 3. 4.						
5.						
7. 8.						
6. 7. 8. 9.				1		
F.	Conductivity	2,82	uslim	oH G	.45	
G.	Dissolved Oz Co	ontent	8.25 m	7/l		. ••

BROUND MAILE SAMPLING FIELD LOG

Samp	ole Location NSB, NEW LONDON	CONN. Well No. 7
Samp	oled By FJF & RPL	Date 6.27.90 Time 11:00
Weat	ther Sunny 80°F	Sampled with Bailer Pump
_		-
A.		
	Well depth: (below top of casing)ft.	Well elevation: (top of casing) 99.76 ft.
	Depth to water table: (below top of casing) 7.6 ft.	Water table elevation: 92.16 ft.
	Length of water column (LWC)	<u>7.4</u> ft.
	Volume of water in well:	
	2" diameter wells = 0.163 4" diameter wells = 0.653 6" diameter wells = 1.469	X (LWC) = 1.2 gallons
В.	PHYSICAL APPEARANCE AT START:	•
	Color CLEAR Odor	NONE Turbidity Low
	Was an oil film or layer apparent?	No
C.	Amount of water removed before samp	oling 3 gallons.
•	Did well go dry? No	
D.	PHYSICAL APPEARANCE DURING SAMPLING	
	Color CLEAR Odor	
	Was an oil film or layer apparent?	No
E.	CONDUCTIVITY	
F.	рН	
6.	TEMPERATURE	
н.	WELL SAMPLING NOTES:	

GROUND MAIER SAPIREING FIELD EUG

	ole Location NSB, NEW LONDO	,					
Sampled By FJF & RPL							
a t	ther Sunny Bo°F	_ Sampled	with	Bailer	<u> </u>	Pump	
	WATER TABLE: Well depth: (below top of casing)15f	t.	Well (top	elevation	on: ng)	9924	f
		Water					•
	Length of water column (LWC)	7.6	_ft.				
	Volume of water in well: 2" diameter wells = 0.10 4" diameter wells = 0.60 6" diameter wells = 1.40	33 X ILWC1	#		GA I	IDDS	
	PHYSICAL APPEARANCE AT START: Color Odor Odor						
	Was an oil film or layer apparent	?	No	· · · · · · · · · · · · · · · · · · ·			
	PREPARATION OF WELL FOR SAMPLING: Amount of water removed before said Did well go dry?			3		gallons	•
	PHYSICAL APPEARANCE DURING SAMPLIS Color <u>SUGHTLY CLOUDY</u> Odor Was an oil film or layer apparent	NONE				LOK-MOD	,
	CONDUCTIVITY						
	рН						
	TEMPERATURE						
	WELL SAMPLING NOTES:	· · · · · · · · · · · · · · · · · · ·					

GROUND WATER SAMPLING FIELD LOG

	ple Location NSB NEW LOW			
Samp	pled By FJF & RPL	Date	27.90 Time	11:30
Weat	ther Sunny 80°F	Sampled wi	th Bailer _/	Pump
A.	WATER TABLE:			
	Well depth: (below top of casing)	ft. (ell elevation: top of casing)	100.00 ft
	Depth to water table: (below top of casing) 7.9			
	Length of water column (LWC)	7./1	t.	
	Volume of water in well:			
	<pre>2" diameter wells = 0 4" diameter wells = 0 6" diameter wells = 1</pre>	.163 x (LWC) = .653 X (LWC) = .469 X (LWC) =	9	allons allons allons
В.	PHYSICAL APPEARANCE AT START:			
	ColorCLEAR TO GRAY Odor			MOD.
	Was an oil film or layer appare	nt?SHE	EN	
: .	PREPARATION OF WELL FOR SAMPLIN	G:		
	Amount of water removed before : Did well go dry?		3	gallons.
D.	PHYSICAL APPEARANCE DURING SAMP	LING:		
	Color GRAY Odor			MOD.
	Was an oil film or layer appare	nt? <i>SH</i>	EEN	
Ξ.	CONDUCTIVITY			
:	рН			
à.	TEMPERATURE			
⊣ .	WELL SAMPLING NOTES:	······································		
7.	WELL SAMPLING NOTES:			
			·	

APPENDIX F IN-SITU CONDUCTIVITY TESTING FIELD LOGS

	PROJE	CT NA	T UFAC	- Gro	ton,	9 de	<u>as</u> e	. J	טא פכ	MBEF	18	67.62	3		
Patrick,				36-	_				LEVAT						_
-	DATE		12/2	0/89				0	BG RE	PRES	SENTATI	ve _ <i>m</i> 1	AR_		
,		_1 is		•							TIME	WATER DEPTH	t	h	H-h H-Ho
7		<i> </i>	7777	STATI	C HEAD	(H)		90	.36	t		14.05	-	86.04	
dame (2)					RADIUS				083	L		13.94	90	86.15	0.97
7		= 	:00				•		2,5	· }		13.88 13.84	120	86,25	0.95
					N RADI					٠ ا		13.80	150		0.94
-	T	- - *		SCREE	N LENG	TH (L)			.27	-		13.74	180	86.32	
			:=0_	INITI	AL HEA	D (Ho)		8	0.04	-		13.67	300	86.42	0.91
н	11.	Щ.		HYDRA	ULIC C	ONDUCT	YTIVI	·:				13.63	360	86.46	0.90
_ }		1			r²ln(L/R)						13.55	780	86.54	0.83
	Но		1.		r ² ln(_		12.84	1380	87.25	0.72
_	Но	計劃	L .	· v _	(0.0	83)21	n (7	,27/	<u>6.25</u>	-)		12,28		87.81	0,59
		料		κ =	(0.0)	L (7.2°	7) (4	270)			11.42	4305	89.67	1 . 1
		⊬ ⊲R DATUM			K=	8.84	X107	F+/5	هد ه۲	. 6	2.076	FT/DAY	17700	10121	
	1	DATUM See													
	0.9	<u> </u>													
	0.7_														
	0.6					<i></i>									
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				•	•		7	MP	(C,0,	000	hs)				



- PROJECT NAUFAC	-Groton, Sub Base	JOB NUMBER	186	2.023			
WELL NUMBER	36-4	ELEVATION					_
DATE 12		OBG REPRES	SENTATI	VE MA	<u> </u>		_
→ -r			TIME	WATER DEPTH	t	h	H-h H-Ho
MININ VIIII	STATIC HEAD (H)	- 90.93		9.20	0	90.55	1
				9.18	10	90.57	0.98
t=0	PIPE RADIUS (r)	_		9.16	25	90.59	
	SCREEN RADIUS (R)	0,25		9.15	43 87	90.63	
t	SCREEN LENGTH (L)	6.96		9.10	125	90.65	0.74
	INITIAL HEAD (Ho)			9.07	171	90.48	
t=0	INITIAL HEAD (HO)	70.33		9.05	227	90,70	
н	HYDRAULIC CONDUCTIVIT	Y:		9.00	360	90.75	0.77
	$K = \frac{r^2 \ln(L/R)}{2LTo}$						
Ho L							
Ho 1 L	$K = \frac{(6.083)^2 \ln (6.96)}{2 (6.96) (4)}$	16/0.25)		<u> </u>	<u> </u>	-	
	2 (6.96) (4	05)		 	<u> </u>	 	
F-⊒R	K=4.06 x 10	-6 DEL # 3 - OF	035 F	TIDAY	1		
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0.6							
0.5							
(To) 0.4							
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0.2			╬╬╬				
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OBRIENSGERE ENGNEERS, NC

	PROJI	ест <u>Л</u>	AUFA	+C-	Grot	1012	C		_	JO	B N	UMBE	R	18	62	.0	23			:⊟-5, 	NC
esi;		NUMBER				•			-			TION									
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` .				SCR	EEN L	ENGTH	(L)		8	3, 8	35	_			ļ	08	190	_	88.52	0.7	71
	ſ				TIAL I											88	310	\Box	88.72		
-	1-	╽┤ ╶ ┖	=0	INI	IIAL I	TEAU	(no)		<u></u> _	, , ,	<u> </u>		<u> </u>	···	10.		430		B8.90	0,5	79
Н	,	17 -		HYD	RAULI	C CON	DUCT	IVI	ry:				-	-	9.9	37	730		89,23 89.65		36
. 1	h			v	= <u>r²</u>	ln(L/	R)						-	·	9.3		2530		90.08	_	22
1	Но		L												10	28	373		90.32	0.	15
_	I I			¥	_ (0)	683	-12	(8.	85/	0.2	<u>(5)</u>									 	
			1_			20	8.8	5) (1,24	. ره			-		\vdash					+	
		⊬ ⊣R			K =	1.1 x	10	'0 F†/52	د ه	-		0.00	<u> </u>	FT/I	\^A 		<u> </u>				
	1	DATUM									=		, , T	• • • • • • • • • • • • • • • • • • • •	'A (
	0.9												1								
****	0.8_																				
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				H	, , , , , , , , , , , , , , , , , , , ,	<u> </u>	##		 	#		X	##	114	$\downarrow \downarrow \downarrow$	##			++++		
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	0.1_			+++		1,00	 	<u> </u>		- †	! 	Eco	2,000	- 	1::	1:1		1 -	3,0∞		
						700	-	•	TIM	nE	(SECO	とりの	-)					-7 -		

PROJECT N	AVFAC Groton, S.	ub Base	JOB NUMBER	1862.0	23		
WELL NUMBER	086-6		ELEVATION				
DATE	12/20/89		OBG REPRES	SENTATIVE	nAR_		
,	,			WATE		h H	-h -Ho
	7777		00/4 1	TIME DEPT		90,20	1
	STATIC HEAD (90.67	9.37	15	90.23 0	1
t:	PIPE RADIUS	-	0.083	9,3'		90.23 0	
	SCREEN RADIUS	S (R) _	0.25	9.36		90,26 0	
^	SCREEN LENGTI	H (L) _	8.07	9.3	3 180	90,77 C	185
	t=0 INITIAL HEAD	(Ho)	90,20	9,2		90.33 0	
н Т	HYDRAULIC CO	NDUCTIVITY:		9.18	960	90.420	.53
				9.15	1260	90.45 0	.47
	$K = \frac{r^2 \ln(L)}{2LT}$	•					
Но	$K = \frac{(0.08)}{2}$	3)2/n (8.6	07/0.25)				
图式	1 2	(8.04) (1,3	395)				
— DATUM	K=	1.06 x 10	-6) Ft/sec or	0.09/ 1	T/DAY		
0.9							
0.8							
0.7_							
0.6							
0.5							
- (To) 0.4							텋
— (То) U.3/							.
0.3							
					= 1,395		
_				10			
0.2							
-							
-							
0.1						/,2∞0	1-1-
U. 1	200 4	100	600	800	1,000	1/200	

PROJECT NAVFAC-	- GROTION CT	JOB NUMBE	R	1267			1-5,1VL
Parama,	_	ELEVATION					-
well numberMW	•	OBG REPRE		VF /	EJE		
•	e 190	ODO REFRE	TIME	WATER		h	H-h H-Ho
THIN WITH		Co. 1		10.6	0	89.16	,
S.	TATIC HEAD (H)	92,16		10.3	30	89.46	.१०
t=00 P	IPE RADIUS (r)	0.083		10.05	60	89.71	.82
S	CREEN RADIUS (R)	0.25		9.7	9D	90.06	.70
			<u></u>	9.4	120	90.36	.60
	CREEN LENGTH (L)	7.4	<u> </u>	9.2	150	90.56	·53
t=0 I	NITIAL HEAD (Ho)	89.16		8.95 8.45	180 300	90.81 91.31	.28
	YDRAULIC CONDUCTIVITY:	•		8.15	420	91.61	-18
		•		7.85	600	91.91	.08
	$K = \frac{r^2 ln(L/R)}{2LTo}$			7.75	720	92.01	.05
1 1 1 1 1 1 1 1		1					
	K = (0.25) In (7.4	10.25)					
	2 (7.4) 225						
DATUM	$= 6.4 \times 10^{-5}$	OR 5.5 FT/	na Y				
0.9							
0.8							
0.7_							
- 0.ε							
0.5							
-(To) 0.4	10 // I						
0.3			4414				
-			 				
0.2							
0.1			-11-1-	9/b			
0 100 200	380 400 500	600 700	800	900			



PROJECT NAV	FAC - GROTCH CT	JOB NUMBE	R	1862.			=:1-5, IVL
	MW-8	ELEVATION					
DATE		OBG REPRE	SENTATI	VE	FJF		
			TIME	WATER DEPTH		h	H-h H-Ho
milli girii	STATIC HEAD (H)	91.84		9.80	Ì	89,00	ı
		0.033		9.55	<i>30</i> 60	29,69 89,94	
t=00				9,30	90	90.19	• 63 • 63
	SCREEN RADIUS (R)			8.90	120	90,34	.62
t	SCREEN LENGTH (L)	7.6		8.70	150	90.54	,54
t=0	INITIAL HEAD (Ho)	89.44		8,55 9,25	180 300	90.69 90.99	<u>. પંદે</u> . 35
н	HYDRAULIC CONDUCTIVITY	:		7.65	\$ COO	ा ≤प	. 10
	r21n(1./R)						
	$K = \frac{r^2 \ln(L/R)}{2LTo}$,					
Ho X TX	$K = \frac{(0.083)^2 \ln (7.6)}{2 (7.6)(280)}$	(0.25)					
	2 (7.6)(280)			 			
PAR DATUM	K = 5.5 × 10 - 6 PT/SEC	ne . 42 m	-lax				
1							
0.9							
8.0							
0.7							
0.6							
0.5							
		102					
To) 0.4							
0.3							
0.2							
0.1	100 150 200 250	300 550	400	450 500	550	600	650

OBRIENSGERE ENGINEERS, NC.

DATE 6.26.90 OBG REPRESENTATIVE FIF **TIME DEPTH t h H-h H-H H-H **TIME DEPTH t h H **TIME DE		NAVFAC - GROTON, CT MW-9		N				_
STATIC HEAD (H) 92.10 TIME DEPTH t h H-H H-H H-H H-H H-H H-H H-H H-H H-H H					VE /	FJF		-
STATIC HEAD (H) 92.10 9.65 0 90.95 1 $t=\infty$ PIPE RADIUS (r) 0.083 8.60 00 91.25 .5 SCREEN RADIUS (R) 0.25 5.45 9.95 .5 $t=\infty$ SCREEN LENGTH (L) 7.1 9.25 1.50 91.05 .2 INITIAL HEAD (Ho) 90.95 91.90 .1 HYDRAULIC CONDUCTIVITY: 2.00 92.07 .1 $K = \frac{r^2 ln(L/R)}{2LT_0}$ $K = \frac{r^2 ln(L/R)}{2LT_0}$ $K = \frac{r^2 ln(L/R)}{2LT_0}$ $C = 0.8$ 0.2 0.4 0.5 0.5 0.5 0.5 0.6 0.7 0.8 0.9 0.4 0.9 0.10 0.9 0.9 0.9 0.9 0.9 0.	•				WATER		h	H-h H-H
The probability of the probabil		STATIC HEAD (H)	92.10			- O	90.95	1
SCREEN RADIUS (R) 0.25 865 90 91.35 .6 2.45 120 81.55 .1 2.45 120								
SCREEN RADIUS (R)	t=00	•			1			6
t=0 INITIAL HEAD (Ho) $\frac{90.95}{90.95}$ $\frac{8.25}{9.10}$ $\frac{180}{200}$ $\frac{91.35}{200}$ $\frac{91.90}{91.90}$. HYDRAULIC CONDUCTIVITY: $\frac{8.20}{91.90}$ $\frac{420}{92.00}$ $\frac{91.90}{92.00}$. $\frac{1}{100}$		SCREEN RADIUS (R)						. 4
The probability The proba		SCREEN LENGTH (L)	7,1				1	. 3
HYDRAULIC CONDUCTIVITY: $\frac{1}{7.05} = \frac{420}{20.05} = \frac{92.05}{20.05}$ $K = \frac{r^2 \ln(L/R)}{2 L T_0}$ $K = \frac{(0.083)^2 \ln(7.1/0.25)}{2(7.1)(Loo)}$ DATUM 0.9 0.8 0.7 0.6 0.5 0.37	t=0	INITIAL HEAD (Ho)	90.95				1	
$K = \frac{r^2 \ln(L/R)}{2LTo}$ $K = \frac{(0.085)^2 \ln(7.1/0.25)}{2[7.1](Loc)}$ $L = \frac{1.0 \times 10^{-5} FT/s_{EL}}{0.9} \text{ or } 0.88 FT/bAY}$ 0.9 0.8 0.7 0.6 0.37 0.37		•	Y:				1	٠.
$K = \frac{2170}{2170}$ $K = \frac{(0.005)^{2} \ln (7.1 / 0.25)}{2 (7.1) (100)}$ $= \frac{1.0 \times 10^{-5} FT/sE}{0.0.5} \text{ or } 0.88 FT/DAY$ 0.9 0.8 0.7 0.6 0.5 0.37 0.37		•			7.95	600	92,05	
$K = \frac{(0.085) \ln (7.1)(0.25)}{2 (7.1)(100)}$ $= 1.0 \times 10^{-5} FT/sE $	是一段				1			
DATUM = 1.0 × 10 ⁻⁵ FT/SEL OR 0.88 FT/DAY 0.9 0.8 0.7 0.6 0.37 0.4 0.3	Ho	(0.093) In (711	10.25)					
DATUM = 1.0 × 10 ⁻⁵ FT/SEL OR 0.88 FT/DAY 0.9 0.8 0.7 0.6 0.37 0.4 0.3		X = (0.000) (160)					 	
0.9 0.8 0.7 0.6 0.5 0.4 0.3				<u> </u>	1	<u> </u>		_
0.8 0.7 0.6 0.5 0.3 0.3	DAIUM							
0.5				-7/DAT				
0.6	0.9	11.0 × 10 17/51	00.00					
0.5	0.9		00.807	-//DA				
0.3	0.9		00.807	-//04				
0.3	0.9		- OK U · ED /	-// // // // // // // // // // // // //				
0.3	0.9 0.8 0.7 0.6		- OK U · ED /					
0.3	0.9 0.8 0.7 0.6		00.807					
	0.9 0.8 0.7 0.6							
	0.9 0.8 0.7 0.6							
0.2	0.9 0.8 0.7 0.6 0.5 0.4							
0.2	0.9 0.8 0.7 0.6 0.5 0.4							
	0.9 0.8 0.7 0.6 0.5 0.4							
	0.9 0.8 0.7 0.6 0.5 0.4 0.3							
	0.9 0.8 0.7 0.6 0.5 0.4 0.3							
	0.9 0.8 0.7 0.6 0.5 0.4 0.3							
	0.9 0.8 0.7 0.6 0.5 0.4 0.3							
	0.9 0.8 0.7 0.6 0.5 0.4 0.3							

APPENDIX G
LABORATORY REPORTS

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Page 1	ickikom	war.	REPURI	MOIA OF OCT IF OF TELETON
Received:	: 11/15/ 89	11/20/8	39 12:30:22	•
REPORT	O'BRIEN & GERE	PREPARED	TOXIKON CORPORATI	ION TO
TO	100 SUMMER ST., SUITE 2904	BY	225 WILDWOOD AVE.	- Almy
	BOSTON, MA 02110		WOBURN, MA 01801	
				CERTIFIED BY
ATTEN	PAUL STEINBURG	ATTEN	PAUL LEZBERG	•
		PHONE	(617) 933-6903	CONTACT JIM
CLIENT	OBRIEN GERE SAMPLES 6			
			S. CERT. STATUS:	TRACE METALS, FLUORIDE, CORROSIVITY
				RM(MF), METALS, MINERALS, VOLATILE
				(ANIDE, PHENOLICS, F. COLIFORM(MF)
		STD. PLA	TE COUNT, NUTRIEN	S, PESTICIDES, O & G, TRIHALOMETHANE
WORK ID		O A MAN	AGER: Michan	J. Bril.
		W.A. HAR	GER. TI COV	
	WATER		,	
	under separate cover			
INVOICE	under separate cover			
SAMPLI	E IDENTIFICATION		TEST CODES and I	IAMES used on this report
01 CB-1A	503	VOLATIL	E HALOCARBONS	
02 CB-1B	TPH	IR TPH BY	IR	
03 CB-4				
04 CB-5				
06 TRIP	BLANK			

	age 2 eceived:	: 1	1/15/89	
!	SAMPLE	ID	C8-1A	 _

REPORT

Work Order # 89-11-144

SAMPLE ID CB-1A	SAMPLE # 01 FRACTIONS: A
	Date & Time Collected 11/14/89 13:05:00 Category WATER
TPH_IRND mg/L,DL=1.0	

TOXIKON CORP.

REPORT

Work Order # 89-11-144

Received: 11/15/89

SAMPLE ID CB-1A	FRACTION 01A	TEST CODE 503	NAME VOLA	TILE HALOCARBONS
	Date & Time Col	lected 11/14/89 13	:05:00	Category WATER

	RESULT	LIMIT	UNITS = ug/L
	17	0.50	Notes and Definitions for this Report:
Benzene			notes and beinnitions for this keport.
Trichloroethene	<u>ND</u>	0.50	CVTD ACTED.
Toluene	18	0.50	EXTRACTED:
Tetrachloroethene	<u>ND</u>	0.50	DATE RUN: <u>11/17/89</u>
Chil or obenzene	ND	0.50	ANALYST: JJS
Ethylbenze ne	<u>ND</u>	0.50	INSTRUMENT: LSC 2000
p-Xylene	2	0.50	DIL. FACTOR:1
o-Xylene	ND	0.50	
Stryene	ND	0.50	
Isopropylbenzene	ND	0.50	ND = not detected at detection limit
Bromobenzene	ND	0.50	
N-Propylbenzene	ND	0.50	
2-Chlorotoluene	ND	0.50	
m-Xylene	ND.	0.50	
4-Chlorotoluene	ND	0.50	
1,3,5-Trimethylbenzene	ND	0.50	
T-Butylbenzene	ND	0.50	
1,2,4-Trimethylbenzene	ND	0.50	
S-Butylbenzene	ND	0.50	
1,3-Dichlorobenzene	ND	0.50	
1,4-Dichlorobenzene	ND	0.50	
4-Isopropyltoluene	ND	0.50	
1,2-Dichlorobenzene	ND	0.50	
N-Butylbenzene	ND	0.50	
1,2,4-Trichlorobenzene	ND	0.50	
Napthalene	ND	0.50	
Hexachlorobutadiene	ND	0.50	
1,2,3-Trichtorobenzene	· ND	0.50	

TOXIKON CORP.

REPORT

Work Order # 89-11-144

Received: 11/15/89

SAMPLE ID CB-1B	SAMPLE # 02 FRACTIONS: A
	Date & Time Collected 11/14/89 13:15:00 Category WATER
• •	
TPH_IR3.2	
mg/L,DL=1.0	\cdot
#g/c,bc=1.0	

TOXIKON CORP.

REPORT

Work Order # 89-11-144

Received: 11/15/89

Results by Sample

SAMPLE ID CB-1B FRACTION 02A TEST CODE 503 NAME VOLATILE HALOCARBONS

Date & Time Collected 11/14/89 13:15:00 Category WATER

	RESULT	LIMIT	UNITS	= ug/L
Benzene	4850	0.50	Notes and Def	initions for this Report:
Trichloroethene	ND	0.50		
Toluene	3680	0.50	EXTRACTED:	
Tetrachloroethene	ND	0.50	DATE RUN:	11/17/89
Chlorobenzene	ND	0.50	ANALYST:	าาร
Ethylbenzene	ND	0.50	INSTRUMENT:	LSC 2000
p-Xylene	633	0.50	DIL. FACTOR:	50
o-Xylene	217	0.50		
Stryene	ND	0.50		
Isopropylbenzene	ND	0.50	ND = not dete	cted at detection limit
Bromobenzene	ND.	0.50		
N-Propylbenzene	ND.	0.50		
2-Chlorotoluene	ND	0.50		
m-Xylene	ND	0.50		
4-Chlorotoluene	ND	0.50		
1,3,5-Trimethylbenzene	351	0.50		
T-Butylbenzene	225	0.50		
1,2,4-Trimethylbenzene	ND	0.50		
S-Butylbenzene	605	0.50		
1,3-Dichlorobenzene	ND	0.50		
1,4-Dichlorobenzene	ND	0.50		
4-Isopropyltoluene	ND	0.50		
1,2-Dichlorobenzene	ND	0.50		
N-Butylbenzene	ND	0.50		
1,2,4-Trichlorobenzene	ND.	0.50		
Napthalene	ND	0.50		
Hexachlorobutadiene	ND	0.50		
1,2,3-Trichlorobenzene	ND	0.50		

 Page 6
 TOXIKON CORP.
 REPORT
 Work Order # 89-11-144

 Received: 11/15/89
 Results by Sample

 | SAMPLE ID CB-4
 SAMPLE # 03 FRACTIONS: A

 | Date & Time Collected 11/14/89 12:50:00 Category WATER

 | TPH_IR___ND

 | mg/L,DL=1.0

TOXIKON CORP.

REPORT

Work Order # 89-11-144

Received: 11/15/89

SAMPLE ID CB-4	FRACTION OJA	TEST CODE 503	NAME VOLATILE HA	LOCARBONS
	Date & Time Col	lected 11/14/89 12	2:50:00 Catego	ry WATER

	RESULT	LIMIT	UNITS	= ug/L
B.====	20	0.50	Notes and Dafi	initions for this Report:
Benzene			HOLES AIR DET	illitions for this kepoit.
Trichloroethene	ND	0.50	EVIDACIED.	
Toluene	ND ND	0.50	EXTRACTED:	44.47.00
Tetrachloroethene	<u>ND</u>	0.50	DATE RUN:	11/17/89
Chlorobenzene	ND	0.50	ANALYST:	JJS
Ethylbenzene	ND ND	0.50	INSTRUMENT:	LSC 2000
p-Xylene	<u>ND</u>	0.50	DIL. FACTOR:	1
o-Xylene	3	0.50		
Stryene	ND	0.50		
Isopropylbenzene	ND	0.50	ND = not detec	cted at detection limit
Bromobenzene	ND	0.50		
N-Propylbenzene	ND	0.50		
2-Chlorotoluene	ND	0.50		
m-Xylene	ND	0.50		
4-Chlorotoluene	ND	0.50		
1,3,5-Trimethylbenzene	ND.	0.50		
T-Butylbenzene	ND.	0.50		
1,2,4-Trimethylbenzene	ND	0.50		
S-Butylbenzene	ND.	0.50		
1,3-Dichlorobenzene	ND	0.50		
1,4-Dichlorobenzene	ND	0.50		
4-Isopropyltoluene	ND	0.50		
1,2-Dichlorobenzene	ND	0.50		
N-Butylbenzene	ND	0.50		
1,2,4-Trichlorobenzene	ND	0.50		
Napthalene	ND	0.50		
Hexachlorobutadiene	ND	0.50		
	ND ND	0.50		
1,2,3-Trichlorobenzene		<u> </u>		

Page 8 TOXIKON CORP. REPORT Work Order # 89-11-144

Received: 11/15/89 Results by Sample

| SAMPLE ID CB-5 SAMPLE # 04 FRACTIONS: A Date & Time Collected 11/14/89 12:35:00 Category WATER

| TPH_IR_____NO mg/L,DL=1.0

TOXIKON CORP.

REPORT

Work Order # 89-11-144

Received: 11/15/89

SAMPLE ID CB-5	FRACTION 04A	TEST CODE 503	NAME VOLA	TILE HALOCARBONS
	Date & Time Col	lected 11/14/89 12	:35:00	Category <u>WATER</u>

	RESULT	LIMIT	UNITS	= ug/L
Benzene	52	0.50	Notes and Def	initions for this Report:
Trichloroethene	ND	0.50		
Toluene	16	0.50	EXTRACTED:	·
Tetrachloroethene	ND	0.50	DATE RUN:	<u>11/17/89</u>
Chlorobenzene	ND	0.50	ANALYST:	<u> 118</u>
Ethylbenzene	ND	0.50	INSTRUMENT:	LSC 2000
p-Xylene	12	0.50	DIL. FACTOR:	1
o-Xylene	6	0.50		
Stryene	ND	0.50		
Isopropylbenzene	ND	0.50	ND = not dete	cted at detection limit
Bromobenzene	ND	0.50		
N-Propylbenzene	ND	0.50		
2-Chlorotoluene	ND	0.50		
m-Xylene	ND	0.50		
4-Chlorotoluene	ND	0.50		
1,3,5-Trimethylbenzene	8	0.50		
T-Butyl benzene	7	0.50		
1,2,4-Trimethylbenzene	ND	0.50		
S-Butyl benzene	10	0.50		
1,3-Dichlorobenzene	ND.	0.50		
1,4-Dichlorobenzene	ND	0.50		
4-Isopropyltoluene	ND	0.50		
1,2-Dichlorobenzene	ND	0.50		
N-Butylbenzene	ND	0.50		
1,2,4-Trichlorobenzene	ND	0.50		
Napthalene	ND	0.50		
Hexachlorobutadiene	ND	0.50		
1,2,3-Trichlorobenzene	ND	0.50		

TOXIKON CORP.

REPORT

Work Order # 89-11-144

Received: 11/15/89

Results by Sample

TOXIKON CORP.

REPORT

Work Order # 89-11-144

Received: 11/15/89

Results by Sample

SAMPLE ID CB-7

FRACTION 05A TEST CODE 503 NAME WOLATILE HALOCARBONS

Date & Time Collected 11/14/89 13:30:00 Category WATER

	RESULT	LIMIT	UNITS = ug/L
Benzene	ND	0.50	Notes and Definitions for this Report:
Trichloroeth ene	ND	0.50	
Toluene	<u>ND</u>	0.50	EXTRACTED:
Tetrachloroethene	ND	0.50	DATE RUN: 11/17/89
Chlorobenzene	ND	0.50	ANALYST: <u>JJS</u>
Ethylbenzene	ND.	0.50	INSTRUMENT: LSC 2000
p-Xylene	ND	0.50	DIL. FACTOR: 1
o-Xylene	ND	0.50	
Stryene	ND	0.50	
Isopropylbenzene	ND	0.50	ND = not detected at detection limit
Bromobenzene	ND	0.50	
N-Propylbenzene	ND	0.50	
2-Chiorotoluene	ND	0.50	
m-Xylene	ND	0.50	
4-Chlorotoluene	ND	0.50	
1,3,5-Trimethylbenzene	ND	0.50	
T-Butylbenzene	ND	0.50	
1,2,4-Trimethylbenzene	ND	0.50	
S-Butylbenzene	ND	0.50	
1,3-Dichlorobenzene	ND	0.50	
1,4-Dichlorobenzene	ND	0.50	
4-Isopropyltoluene	ND	0.50	
1,2-Dichlorobenzene	ND	0.50	
N-Butylbenzene	ND.	0.50	
1,2,4-Trichlorobenzene	ND.	0.50	
Napthalene	ND.	0.50	
Hexachlorobutadiene	ND	0.50	
1,2,3-Trichlorobenzene	ND	0.50	

TOXIKON CORP.

REPORT

Work Order # 89-11-144

Received: 11/15/89

Results by Sample

SAMPLE ID TRIP BLANK

FRACTION 06A TEST CODE 503 NAME VOLATILE HALOCARBONS

Date & Time Collected 11/14/89

Category WATER

	RESULT	LIMIT	UNITS	= ug/L
Benzene	ND	0.50	Notes and Def	initions for this Report:
Trichloroethene	ND.	0.50		
Toluene	ND	0.50	EXTRACTED:	
Tetrachloroethene	ND	0.50	DATE RUN:	<u>11/17/89</u>
Chlorobenzene	<u>ND</u>	0.50	ANALYST:	<u>112</u>
Ethylbenzene	ND	0.50	INSTRUMENT:	LSC 2000
p-Xylene	<u> </u>	0.50	DIL. FACTOR:	1
o-Xylene	ND	0.50		
Stryene	ND	0.50		
Isopropylbenzene	ND ND	0.50	ND = not dete	cted at detection limit
Bromobenzene	ND.	0.50		
N-Propylbenzene	ND	0.50		
2-Chlorotoluene	ND	0.50		
m-Xylene	ND	0.50		
4-Chlorotoluene	ND.	0.50		
1,3,5-Trimethylbenzene	ND.	0.50		
T-Butylbenzene	ND.	0.50		
1,2,4-Trimethylbenzene	ND	0.50		
S-Butyl benzene	ND	0.50		
1,3-Dichlorobenzene	ND	0.50		
1,4-Dichlorobenzene	ND	0.50		
4-Isopropyltoluene	ND	0.50		
1,2-Dichlorobenzene	ND	0.50		
N-Butylbenzene	ND	0.50		
1,2,4-Trichlorobenzene	ND	0.50		
Napthalene	ND	0.50		
Hexachlorobutadiene	ND	0.50		
1,2,3-Trichlorobenzene	ND	0.50		

TOXIKON CORP.

REPORT

Work Order # 89-11-144

Received: 11/15/89

Test Methodology

TEST CODE 503 NAME VOLATILE HALOCARBONS

EPA Method: 503

Reference: Test Methods for Evaluating Solid Waste: Physical/Chemical

Methods. EPA SW-846 (Third Edition) 1986.

Office of Solid Waste, USEPA.

TEST CODE THE IR NAME THE BY IR

EPA METHOD: 418.1 for water sample.

Reference: Methods for Chemical Analysis of Water and Wastes.

EPA 600/4-79-020 (Revised, March 1983). EPA/EMSL, Cincinnati, OH.

EPA METHOD: 9071 for soil sample.

Reference: Test Methods for Evaluating Solid Waste: Physical/Chemical Methods.

EPA SW-846 (Third Edition) 1986. Office of Solid Waste, USEPA.

Page 1 Received:			REPORT 90 09:28:02	Work Order # 89-12-070
REPORT TO	O'BRIEN & GERE 100 SUMMER ST., SUITE 2904 BOSTON, MA 02110	PREPARED BY	TOXIKON CORPORATION	- Jan 5.2
	MARK RANDAZZO	_ ATTEN		CERVIFIED BY
COMPANY	OBRIEN GERE SAMPLES _ O'BRIEN & GERE	DEGE MAS	S. CERT. STATUS: TRAC SODIUM, T. COLIFORM(MF)	CE METALS, FLUORIDE, CORROSIVITY), METALS, MINERALS, VOLATILE E, PHENOLICS, F. COLIFORM(MF)
WORK ID	OBG-1, OBG-4, TRIP BLANK	STD. PLA	TE COUNT, NUTRIENTS, PE	ESTICIDES, O & G, TRIHALOMETHANE
TRANS TYPE P.O. #	SOIL	Previous	/	
	IDENTIFICATION		TEST CODES and KAMES	used on this report
02 OBG-4 03 OBG-1		P FUEL OI	L FINGERPRINT	

05 TRIP BLANK

TOXIKON CORP.

REPORT

Work Order # 89-12-070

Received: 12/11/89

Results by Sample

REPORT

Work Order # 89-12-070

Received: 12/11/89

Results by Sample

SAMPLE ID OBG-4, (0'-3' & 3.5'-5.5') FRACTION O1A TEST CODE 801020 NAME PURGEABLE HAL. & ARO. SOIL

Date & Time Collected 12/05/89 Category SOIL COMP

	RESULT L	IMIT	UNITS =	ug/Kg	RESULT	LI	MIT
EPA 8010				EPA 8020			
Chloromethane	ND _	2.0	Benzene			ND	2.0
Bromomethane	ND _	2.0	Toluene			ND	2.0
Vinyl Chloride	ND	2.0	Ethylbenzene			ND	2.0
Dichlorodifluoromethane	ND _	2.0	Xylenes (Total)			ND	2.0
Chloroethane	ND _	2.0			•		
Methylene Chloride	ND _	2.0					
Trichlorofluoromethane	ND	2.0					
1,1-Dichloroethene	ND -	2.0					
1,1-Dichloroethane	ND _	2.0					
trans-1,2-Dichloroethene	ND _	2.0					
Chloroform	ND _	2.0					
1,2-Dichloroethane	ND	2.0					
1,1,1-Trichloroethane	ND	2.0					
Carbon tetrachloride	ND _	2.0					
Bromodichloromethane	ND	2.0					
1,2-Dichloropropane	ND	2.0					
Trans-1,3-Dichloropropane	ND _	2.0					
Trichloroethene	ND _	2.0					
cis-1,3-Dichloropropene	ND _	2.0					
1,1,2-Trichloroethane	ND _	2.0					
Dibromochloromethane	ND _	2.0					
2-Chloroethylvinyl ether	ND	2.0					
Bromoform	<u>ND</u>	2.0					
1,1,2,2-Tetrachloroethane	<u>ND</u>	2.0					
Tetrachloroethene	ND	2.0					
Chlorobenzene	ND	2.0					
1,4-Dichlorobenzene	ND	2.0					
1,3-Dichlorobenzene	ND	2.0					
1,2-Dichlorobenzene	ND _	2.0					

Notes and Definitions for this Report:

EXTRACTED:

DATE RUN: 12/11/89

ANALYST: JJS

INSTRUMENT: LSC 2000

DIL. FACTOR: 1

ND = not detected at detection limit

Page 4 Received:	12/11/89	TOXIKON CORP. Result	REPORT s by Sample	Work Order # 89-12-070)
SAMPLE ID	OBG-4, (5.51-7.51)		<u>D2A</u> TEST CODE <u>FOFP</u> ne Collected <u>12/05/89</u> (NAME <u>FUEL OIL FINGERPRINT</u> 01:15:00 Category <u>SOIL</u>	
		RESULT	UNITS NA		
NO.	2 FUEL OIL		ND		
NO.	4 FUEL OIL		ND ND		
NO.	6 FUEL OIL		ND		
GAS	DLINE		ND		
PETI	ROLEUM CONTAMINANT N.	o.s	ND		
		Notes and Definit	ions for this Report:		

ND = NOT DETECTED AT DETECTION LIMIT N.O.S. = NOT OTHERWISE SPECIFIED

12/27/89

12/28/89 DB

GCFID

___1

EXTRACTED: DATE RUN:

ANALYST:

INSTRUMENT: CONC FACTOR:

TOXIKON CORP.

REPORT

Work Order # 89-12-070

Received: 12/11/89

SAMPLE ID 08G-1, (0'-3'& 3'-5')	SAMPLE # 03 FRACTIONS: A
	Date & Time Collected 12/07/89 Category SOIL COMP
TPH_IR163	
mg/Kg,DL=40	

REPORT

Work Order # 89-12-070

Received: 12/11/89

Results by Sample

SAMPLE ID OBG-1, (0'-3'& 3'-5') FRACTION O3A TEST CODE 801020 NAME PURGEABLE HAL. & ARO. SOIL Date & Time Collected 12/07/89 Category SOIL COMP

	RESULT L	IMIT	UNITS :	= ug/Kg	RESULT	LI	MIT
EPA 8010				EPA 8020			
Chloromethane	ND	2.0	Benzene			3	2.0
Bromomethane	ND	2.0	Toluene			_7	2.0
Vinyl Chloride	ND	2.0	Ethylbenzene			ND	2.0
Dichlorodifluoromethane	ND	2.0	Xylenes (Total)			<u>35</u>	2.0
Chloroethane	ND _	2.0					
Methylene Chloride	ND	2.0					
Trichlorofluoromethane	ND	2.0					
1,1-Dichloroethene	· ND	2.0					
1,1-Dichloroethane	ND	2.0					
trans-1,2-Dichloroethene	ND	2.0					- '
Chloroform	ND	2.0					
1,2-Dichloroethane	ND _	2.0					
1,1,1-Trichloroethane	ND	2.0					•
Carbon tetrachloride	ND ND	2.0					
Bromodichloromethane	ND	2.0					
1,2-Dichloropropane	ND	2.0					
Trans-1,3-Dichloropropane	ND ND	2.0					
Trichloroethene	<u>ND</u>	2.0					
cis-1,3-Dichloropropene	ND	2.0					
1,1,2-Trichloroethane	ND	2.0					
Dibromochloromethane	ND	2.0					
2-Chloroethylvinyl ether	ND	2.0			•		
Bromoform	ND ND	2.0					
1,1,2,2-Tetrachloroethane	ND	2.0					
Tetrachloroethene	ND	2.0					
Chlorobenzene	ND	2.0					
1,4-Dichlorobenzene	ND	2.0					
1,3-Dichlorobenzene	ND	2.0					
1,2-Dichlorobenzene	ND ND	2.0					

Notes and Definitions for this Report:

EXTRACTED:

DATE RUN: 12/11/89

ANALYST: JJS

INSTRUMENT: LSC 2000

DIL. FACTOR: 1

ND = not detected at detection limit

Page	7		
		_	

REPORT

Work Order # 89-12-070

Received: 12/11/89

Results by Sample

SAMPLE ID 08G-1, (7'-9')	FRACTION <u>04A</u> TEST CODE <u>FOFP</u> NAME <u>FUEL</u>	OIL FINGERPRINT
l de la companya de	Date & Time Collected <u>12/05/89 12:30:00</u>	Category SOIL

Notes and Definitions for this Report:

 EXTRACTED:
 12/27/89

 DATE RUN:
 12/28/89

 ANALYST:
 DB

 INSTRUMENT:
 GCFID

 CONC FACTOR:
 1

ND = NOT DETECTED AT DETECTION LIMIT N.O.S. = NOT OTHERWISE SPECIFIED

REPORT

Work Order # 89-12-070

Received: 12/11/89

Results by Sample

SAMPLE ID TRIP BLANK	FRACTION <u>05A</u>	TEST CODE 801020	NAME PURGEABLE HAL. & ARO. SOIL
	Date & Time Col	lected <u>12/07/89</u>	Category <u>SOIL</u>

	RESULT LIM	IIT UNITS	= ug/Kg	RESULT L	IMIT
EPA 8010			EPA 8020		
Chloromethane	<u>ND 2</u>	2.0 Benzene		ND	2.0
Bromomethane	<u>ND</u> 2	2.0 Toluene		ND	2.0
Vinyl Chloride	<u>ND 2</u>	2.0 Ethylbenzene		ND	2.0
Dichlorodifluoromethane	<u>ND 2</u>	2.0 Xylenes (Total)		ND	2.0
Chloroethane	<u>ND</u> 2	<u>2.0</u>			
Methylene Chloride	<u>ND</u> 2	2.0			
Trichlorofluoromethane	<u>ND 2</u>	2.0			
1,1-Dichloroethene	<u>ND</u> 2	2.0			
1,1-Dichloroethane	<u>ND 2</u>	2.0			
trans-1,2-Dichloroethene	<u>ND</u> 2	2.0			
Chloroform	<u>ND 2</u>	2.0			
1,2-Dichloroethane	<u>ND 2</u>	2.0			
1,1,1-Trichloroethane	<u>ND 2</u>	2.0			
Carbon tetrachloride	<u>ND</u> 2	2.0			
Bromodichloromethane	<u>ND 2</u>	2.0			
1,2-Dichloropropane	<u>ND 2</u>	2.0			
Trans-1,3-Dichloropropane	<u>ND 2</u>	2.0			
Trichloroethene	<u>ND 2</u>	2.0			
cis-1,3-Dichloropropene	<u>ND 2</u>	2.0			
1,1,2-Trichloroethane	<u>ND 2</u>	2.0			
Dibromochloromethane	<u>ND 2</u>	2.0			
2-Chloroethylvinyl ether	<u>ND 2</u>	2.0			
Bromoform	<u>ND 2</u>	2.0			
1,1,2,2-Tetrachloroethane	<u>ND</u> 2	2.0			
Tetrachloroethene	<u>ND</u> 2	2.0			
Chlorobenzene	ND 2	2.0			
1,4-Dichlorobenzene	ND 2	2.0			
1,3-Dichlorobenzene	ND 2	2.0			
1,2-Dichlorobenzene		2.0			

Notes and Definitions for this Report:

EXTRACTED:

DATE RUN: 12/11/89

ANALYST: JJS
INSTRUMENT: LSC 2000

DIL. FACTOR: 1

ND = not detected at detection limit

TOXIKON CORP.

REPORT

Work Order # 89-12-070

Received: 12/11/89

Test Methodology

TEST CODE 801020 NAME PURGEABLE HAL. & ARO. SOIL

EPA Method: 8010 & 8020

Reference: Test Methods for Evaluating Solid Waste: Physical/Chemical

Methods. EPA SW-846 (Third Edition) 1986.

Office of Solid Waste, USEPA.

TEST CODE FOFP NAME FUEL OIL FINGERPRINT

EPA METHOD: D3710

Reference: Methods for Organic Chemical Analysis of Municipal and

Industrial Wastewater. Appendix A. 40CFR Part 136.

Federal Register Vol. 49, No. 209, 1984.

TEST CODE THE IR NAME THE BY IR

EPA METHOD: 418.1 for water sample.

Reference: Methods for Chemical Analysis of Water and Wastes.

EPA 600/4-79-020 (Revised, March 1983). EPA/EMSL, Cincinnati, OH.

EPA METHOD: 9071 for soil sample.

Reference: Test Methods for Evaluating Solid Waste: Physical/Chemical Methods.

EPA SW-846 (Third Edition) 1986. Office of Solid Waste, USEPA.

Page 1	TOXIKON	CORP.	REPORT	Wor	k Order # 89-12-166
Received: 12/16/89		01/09/9	0 16:59:48	¥or	k Not Complete
					1.
REPORT O'BRIEN & GERE					Stow Sil
TO 100 SUMMER ST., SUITE	2904		225 WILDWOOD AVE.		-
BOSTON, MA 02110			WOBURN, MA 01801		
					CERTIFIED BY
ATTEN MARK A. RANDAZZO			PAUL LEZBERG		CONTACT JIM
			(617) 933-6903		CORTACT SIM
CLIENT OBRIEN GERE SAN COMPANY O'BRIEN & GERE			CEDT CTATUE.	TOACE METALS	ELLIOPINE COPPOSIVITY
FACILITY		DEME MASS	CONTINUE T COLLECT	MINEL METALS	MINEPALS VOLATILE
PACILITY	····································				ICS, F. COLIFORM(MF)
					, O & G, TRIHALOMETHANE
WORK ID GROTON, SUB BASE		<u>UIUI TUMI</u>	L GOONT, NOTHICK		
TAKEN NEX GAS STATION					
TRANS		Previous	v Reported on 01.	/09/90.	
TYPE SOIL & WATER					
P.O. #					
INVOICE under separate cover					
SAMPLE IDENTIFICATION			TEST CODES and I	NAMES used on	this report
01 OBG-2 (9'-11')	503	VOLATILE	HALOCARBONS	_	
02 08G-5 (71-91)	8010	PURGEABL	E HALOCARBONS SO	<u>IL</u>	
03 08G-6(7'-9')	8020	PURGEABL	E AROMATICS SOI	<u>L</u>	
04 OBG-6(9-11')	FE	IRON			
05 OBG-1(F.P)	FOFP	S FUEL OII	L FINGERPRINT (S)	_	
06 OBG-2(F.P.)	FOFP	W FUEL OIL	L FINGERPRINT (W)	_	
07 OBG-4	HARD	NE TOTAL H	ARDNESS		
08 OBG-4	MN	MANGANES	<u>SE</u>		
09 OBG-1	TPH	IR TPH BY	IR		
10 OBG-1	<u>T EX</u>	W TOTAL EX	KTRACTION	_	
11 CB-5					
12 CB-5					
13 OBG-2					
14 OBG-2					
15 CB-4					•
16 CB-4					
17 CB-1B					
18 CB-18					
19 CB-1A					
20 CB-1A					
21 CB-7					
22 CB-7					
23 TRIP BLANK 24 OBG-2					
F4 000 E					

TOXIKON CORP.

REPORT

Work Order # 89-12-166

Received: 12/16/89

SAMPLE 1D OBG-2 (9'-11')	SAMPLE # 01 FRACTIONS: A	Catagory COII
<u> </u>	Date & Time Collected 12/13/89	Category <u>SOIL</u>
TPH_IR2240 mg/Kg,DL=40		
i	•	

TOXIKON CORP.

REPORT

Work Order # 89-12-166

Received: 12/16/89

Results by Sample

SAMPLE ID 08G-2 (9'-11')

FRACTION <u>01A</u> TEST CODE <u>8010</u> NAME <u>PURGEABLE HALOCARBONS SOIL</u>

Date & Time Collected <u>12/13/89</u> Category <u>SOIL</u>

	RESULT	LIMIT	UNITS = ug/Kg
Chloromethane	ND	2.0	
Bromomethane	ND	2.0	
Vinyl Chloride	ND	2.0	
Dichlorodifluoromethane	ND	2.0	
Chloroethane	ND	2.0	Notes and Definitions for this Report:
Methylene Chloride	ND	2.0	
Trichlorofluoromethane	ND	2.0	EXTRACTED:
1.1-Dichloroethene	ND		DATE RUN: 12/19/89
1,1-Dichloroethane	ND	2.0	ANALYST: JJS
trans-1,2-Dichloroethene	ND	2.0	INSTRUMENT: LSC 2
Chloroform	ND	2.0	DIL. FACTOR: 100
1,2-Dichloroethane	ND		
1,1,1-Trichloroethane	ND.	2.0	
Carbon tetrachloride	ND.	2.0	
Bromodichloromethane	ND	2.0	ND = not detected at detection limit
1,2-Dichloropropane	ND.	2.0	
Trans-1,3-Dichloropropane	ND	2.0	
Trichloroethene	ND	2.0	
cis-1,3-Dichloropropene	ND	2.0	
1,1,2-Trichloroethane	ND	2.0	
Dibromochloromethane	ND.	2.0	
2-Chloroethylvinyl ether	ND	2.0	
Bromoform	ND.	2.0	
1,1,2,2-Tetrachloroethane	ND	2.0	
Tetrachloroethene	ND	2.0	
Chlorobenzene	ND		
1,4-Dichlorobenzene	ND	. ——	
1,3-Dichlorobenzene	ND	2.0	
1,2-Dichlorobenzene	ND	2.0	

 Page 4
 TOXIKON CORP.
 REPORT
 Work Order # 89-12-166

 Received: 12/16/89
 Results by Sample

 SAMPLE ID 08G-2 (9'-11')
 FRACTION 01A TEST CODE 8020 NAME PURGEABLE AROMATICS SOIL Date & Time Collected 12/13/89 Category SOIL

 RESULT LIMIT UNITS = ug/Kg

 BENZENE
 32270 2.0

71235 2.0

147100 2.0

Notes and Definitions for this Report:

EXTRACTED:

TOLUENE

ETHYLBENZENE

XYLENES (TOTAL)

DATE RUN: 1

12/19/89

ND = not detected at detection limit

ANALYST:

<u>JJS</u>

INSTRUMENT:

LSC 2

DIL. FACTOR:

TOXIKON CORP.

REPORT

Work Order # 89-12-166

Received: 12/16/89

SAMPLE ID OBG-5 (7'-9')	SAMPLE # 02 FRACTIONS: A	
	Date & Time Collected 12/14/89	Category SOIL
TPH_IR11400		
mg/Kg,DL=40		

TOXIKON CORP.

REPORT

Work Order # 89-12-166

Received: 12/16/89

Results by Sample

SAMPLE ID 08G-5 (71-91)

FRACTION 02A TEST CODE 8010 NAME PURGEABLE HALOCARBONS SOIL

Date & Time Collected 12/14/89 Category SOIL

	RESULT	LIMIT	UNITS =	ug/Kg
Chloromethane	ND	2.0		
Bromomethane	ND.	2.0		
Vinyl Chloride	ND	2.0		
Dichlorodifluoromethane	ND ND	2.0		
Chloroethane	ND.	2.0	Notes and Defin	nitions for this Report:
•	ND.	2.0	NOTES SILE SOLL	
Methylene Chloride Trichlorofluoromethane	ND.	2.0	EXTRACTED:	
	ND.	2.0	DATE RUN:	12/19/89
1,1-Dichloroethene	ND ND	2.0	ANALYST:	JJS
1,1-Dichloroethane	ND ND	2.0	INSTRUMENT:	LSC 2
trans-1,2-Dichloroethene	ND ND	2.0	DIL. FACTOR:	25
Chloroform	ND ND	2.0	DIE. PACION.	
1,2-Dichloroethane	ND ND			
1,1.1-Trichloroethane		2.0		
Carbon tetrachloride	ND ND	2.0	ND - met detect	ted at detection limit
Bromodichloromethane	ND ND	2.0	NU = not detect	ted at detection timit
1,2-Dichloropropane	ND			
Trans-1,3-Dichloropropane	ND	2.0		
Trichloroethene	<u>ND</u>			
cis-1,3-Dichloropropene	ND			
1,1,2-Trichloroethane	ND			
Dibromochloromethane	<u>ND</u>	2.0		
2-Chloroethylvinyl ether	ND	2.0		
Bromoform	ND.	2.0		
1,1,2,2-Tetrachloroethane	ND	2.0		
Tetrachloroethene	ND.	2.0		
Chlorobenzene	ND	2.0		
1,4-Dichlorobenzene	ND.	2.0		
1,3-Dichlorobenzene	ND.	2.0		
1,2-Dichlorobenzene	ND	2.0		

TOXIKON CORP. REPORT Work Order # 89-12-166 Page 7 Received: 12/16/89 Results by Sample FRACTION 02A TEST CODE 8020 NAME PURGEABLE AROMATICS SOIL SAMPLE ID OBG-5 (7'-9') Date & Time Collected 12/14/89 Category SOIL UNITS = ug/Kg RESULT LIMIT BENZENE 310 2.0 TOLUENE 200 2.0 ETHYLBENZENE 40 2.0 XYLENES (TOTAL) 950 2.0

Notes and Definitions for this Report:

EXTRACTED:

DATE RUN:

12/19/89

ANALYST:

<u>JJS</u>

INSTRUMENT:

LSC 2

DIL. FACTOR: 25

ND = not detected at detection limit

TOXIKON CORP.

REPORT

Work Order # 89-12-166

Received: 12/16/89

SAMPLE ID 08G-6(7'-9')	SAMPLE # 03 FRACTIONS: A	SAMPLE # 03 FRACTIONS: A				
	Date & Time Collected 12/14/89	Category SOIL				
TPH_IR3900						
mg/Kg,DL=40	•					
	grander					

TOXIKON CORP.

REPORT

Work Order # 89-12-166

Received: 12/16/89

Results by Sample

SAMPLE ID <u>OBG-6(71-91)</u>

FRACTION 03A TEST CODE 8010 NAME PURGEABLE HALOCARBONS SOIL
Date & Time Collected 12/14/89 Category SOIL

	RESULT	LIMIT	UNITS = ug/Kg
Chloromethane	ND	2.0	
Bromomethane	ND	2.0	
Vinyl Chloride	ND.	2.0	
Dichlorodifluoromethane	ND.	2.0	
Chloroethane	ND	2.0	Notes and Definitions for this Report:
Methylene Chloride	ND	2.0	
Trichlorofluoromethane	ND	2.0	EXTRACTED:
1,1-Dichloroethene	ND	2.0	DATE RUN: 12/19/89
1,1-Dichloroethane	ND	2.0	ANALYST: JJS
trans-1,2-Dichloroethene	ND	2.0	INSTRUMENT: LSC 2
Chloroform	ND	2.0	DIL. FACTOR:25
1,2-Dichloroethane	ND	2.0	
1,1,1-Trichloroethane	ND	2.0	
Carbon tetrachloride	ND	2.0	
Bromodichloromethane	ND	2.0	ND = not detected at detection limit
1,2-Dichloropropane	ND	2.0	
Trans-1,3-Dichloropropane	ND	2.0	
Trichloroethene	ND.	2.0	
cis-1,3-Dichloropropene	ND	2.0	
1,1,2-Trichloroethane	ND.	2.0	
Dibromochloromethane	ND	2.0	
2-Chloroethylvinyl ether	ND	2.0	
Bromoform	ND	2.0	
1,1,2,2-Tetrachloroethane	ND	2.0	
Tetrachloroethene	ND	2.0	
Chlorobenzene	ND	2.0	
1,4-Dichlorobenzene	ND.	2.0	
1,3-Dichlorobenzene	ND	2.0	
1,2-Dichlorobenzene	ND.	2.0	

TOXIKON CORP.

REPORT

Work Order # 89-12-166

Received: 12/16/89

Results by Sample

SAMPLE ID 08G-6(71-91)

FRACTION 03A TEST CODE 8020 NAME PURGEABLE AROMATICS SOIL

Date & Time Collected 12/14/89

Category SOIL

RESULT

LIMIT

UNITS = ug/Kg

BENZENE

280 2.0

TOLUENE

<u>13191</u> 2.0

ETHYLBENZENE

60 2.0

XYLENES (TOTAL)

<u>810</u> 2.0

Notes and Definitions for this Report:

EXTRACTED:

DATE RUN: 12/19/89

ANALYST:

<u>JJS</u>

25

INSTRUMENT:

LSC 2

DIL. FACTOR:

ND = not detected at detection limit

Page 11 TOXIKON CORP. REPORT Work Order # 89-12-166 Results by Sample Received: 12/16/89 FRACTION 04A TEST CODE FOFPS NAME FUEL OIL FINGERPRINT (S) SAMPLE ID OBG-6(9-11") Date & Time Collected 12/14/89 Category SOIL UNITS ≈ Qualitative RESULT GASOLINE NOT PRESENT KEROSENE PRESENT DIESEL FUEL PRESENT NO. 2 FUEL OIL NOT PRESENT NO. 4 FUEL OIL NOT PRESENT NO. 6 FUEL OIL NOT PRESENT PETROLEUM CONTAMINANT N.O.S. Notes and Definitions for this Report: EXTRACTED:

ND = NOT DETECTED AT DETECTION LIMIT
N.O.S. = NOT OTHERWISE SPECIFIED

12/21/89

DJB

DATE RUN:

ANALYST:

INSTRUMENT: DIL. FACTOR:

QUALITATIVE DETECTION LIMIT = 1 PPB

Page 12	TOXIKON CORP.	REI	PORT	Work Order # 89-12-166	
Received: 12/16/89	Re	sults by Sample	e		
SAMPLE ID OBG-1(F.P)	•	ON <u>05A</u> TEST Time Collected		NAME <u>FUEL OIL FINGERPRINT (W)</u> Category <u>OIL WATER</u>	- -
• •					
	RESULT	UNI	TS = Qualitat	ive	
GASOLINE	***************************************	PRESENT			
KEROSENE		NOT PRESENT			
DIESIL FUEL		NOT PRESENT			
NO. 2 FUEL OIL		NOT PRESENT			
NO. 4 FUEL OIL		NOT PRESENT			
NO. 6 FUEL OIL		NOT PRESENT			
PETROLEUM CONTAMINANT N.	o.s	NOT PRESENT			
	Notes and Defi	nitions for th	is Report:		
	EXTRACTED: DATE RUN: ANALYST: INSTRUMENT: DIL. FACTOR:	12/21/89 DJB 			

ND = NOT DETECTED AT DETECTION LIMIT N.O.S. = NOT OTHERWISE SPECIFIED

QUALITATIVE DETECTION LIMIT = 1 PPB

Page 13	TOXIKON CORP.		REPORT	Work	Order # 89-12-16	56
Received: 12/16/89	Re	sults by	Sample			
SAMPLE ID OBG-2(F.P.)	FRACT	ON <u>06A</u>	TEST CODE FOFPU	NAME FUEL	OIL FINGERPRINT	r (¥)
	Date 8	Time Co	llected <u>12/15/89</u>		Category <u>OIL</u>	
	_					
					, and	
	RESUL	г	UNITS = Qualita	tive		
GASOLINE		P	RESENT			
KEROSENE		NOT P	RESENT			
DIESIL FUEL		NOT P	RESENT			
NO. 2 FUEL OIL		NOT P	RESENT			
NO. 4 FUEL OIL		NOT P	RESENT			
NO. 6 FUEL OIL	***************************************	NOT P	RESENT			
PETROLEUM CONTAMINANT N	.0.\$.	NOT P	RESENT			
	Notes and Def	initions	for this Report:			
	EXTRACTED:		<u>. </u>			
	DATE RUN:	12/21/8	<u>9</u>			
	ANALYST:	<u>DJB</u>				
	INSTRUMENT:	<u>G</u>	<u>:1</u>			
	DIL. FACTOR:	1				
	ND = NOT DETE	CTED AT D	ETECTION LIMIT			

N.O.S. = NOT OTHERWISE SPECIFIED

QUALITATIVE DETECTION LIMIT = 1 PPB

TOXIKON CORP.

REPORT

Work Order # 89-12-166

Received: 12/16/89

SAMPLE # 07 FRACTIONS: A	
Date & Time Collected 12/15/89	Category WATER

TOXIKON CORP.

REPORT

Work Order # 89-12-166

Received: 12/16/89

SAMPLE ID OBG-4	FRACTION <u>OSA</u>	TEST CODE 503	NAME VOLATILE HALOCARBONS
	Date & Time Co	llected <u>12/15/89</u>	Category WATER

	RESULT	LIMIT	UNITS = ug/L	
Benzene	21	0.50	Notes and Defi	initions for this Report:
Trichloroethene	ND	0.50		
Toluene	6	0.50	EXTRACTED:	
Tetrachloroethene	ND	0.50	DATE RUN:	12/26/89
Chlorobenzene	<u>ND</u>	0.50	ANALYST:	712
Ethylbenzene	ND	0.50	INSTRUMENT:	LSC 2000
p-Xylene	0.8	0.50	DIL. FACTOR:	1
o-Xylene	0.9	0.50		
Stryene	ND	0.50		
Isopropylbenzene	ND	0.50	ND = not detec	ted at detection limit
Bromobenzene	ND.	0.50		
N-Propylbenzene	ND	0.50		
2-Chlorotoluene	ND.	0.50		
m-Xylene	<u>ND</u>	0.50		
4-Chlorotoluene	ND	0.50		
1,3,5-Trimethylbenzene	ND	0.50		
T-Butylbenzene	ND	0.50		
1,2,4-Trimethylbenzene	ND	0.50		
S-Butylbenzene	ND	0.50		
1,3-Dichlorobenzene	ND	0.50		
1,4-Dichlorobenzene	ND	0.50		
4-Isopropyltoluene	ND	0.50		
1,2-Dichlorobenzene	ND.	0.50		
N-Butylbenzene	ND ND	0.50		
1,2,4-Trichlorobenzene	ND	0.50		
Napthalene	ND	0.50		
Hexachlorobutadiene	ND ND	0.50		
1,2,3-Trichlorobenzene	ND	0.50		

TOXIKON CORP.

REPORT

Work Order # 89-12-166

Received: 12/16/89

SAMPLE ID OBG-1	FRACTION 09A	TEST CODE 503	NAME VOLATILE HALOCARBONS
·	Date & Time Col	lected 12/15/89	Category WATER

	RESULT	LIMIT	UNITS = ug/L		
Benz ene	<u>43995</u>	0.50	Notes and Def	initions for this Report:	
Trichloroethene	ND	0.50			
Toluene	100570	0.50	EXTRACTED:	-	
Tetrachloroeth ene	ND.	0.50	DATE RUN:	12/22/89	
Chlorobenzene	MD	0.50	ANALYST:	<u>112</u>	
Ethylbenzene	22420	0.50	INSTRUMENT:	LSC 2000	
p-Xylene	36540	0.50	DIL. FACTOR:	100	
o-Xylene	15720	0.50			
Stryene	ND	0.50			
Isopropylbenzene	ND	0.50	ND = not deter	cted at detection limit	
Bromobenzene	ND	0.50			
N-Propylbenzene	6250	0.50			
2-Chlorotoluene	ND	0.50			
m-Xylene	ND	0.50			
4-Chlorotoluene	ND	0.50			
1,3,5-Trimethylbenzene	4240	0.50			
T-Butylbenzene	ND	0.50			
1,2,4-Trimethylbenzene	ND	0.50			
S-Butylbenzene	ND	0.50			
1,3-Dichlorobenzene	ND	0.50			
1,4-Dichlorobenzene	ND	0.50			
4-Isopropyltoluene	ND	0.50			
1,2-Dichlorobenzene	ND	0.50			
N-Butylbenzene	ND	0.50			
1,2,4-Trichlorobenzene	ND	0.50			
Napthalene	ND	0.50			
Hexachlorobutadiene	ND	0.50			
1,2,3-Trichlorobenzene	ND	0.50			

TOXIKON CORP. Page 17 REPORT Work Order # 89-12-166 Received: 12/16/89 Results by Sample SAMPLE ID DBG-1 SAMPLE # 10 FRACTIONS: A Date & Time Collected 12/15/89 _ Category WATER TPH_IR_____5090 mg/L DL=1 SAMPLE ID CB-5 SAMPLE # 11 FRACTIONS: A Date & Time Collected 12/15/89 Category WATER TPH_IR___ mg/L DL=1

TOXIKON CORP.

REPORT

Work Order # 89-12-166

Received: 12/16/89

SAMPLE ID CB-5	FRACTION 12A	TEST CODE 503	NAME VOLATILE HALOCARBONS
	Date & Time Co	llected 12/15/89	Category WATER

	RESULT	LIMIT	UNITS	= ug/L
				•
Benzene	95	0.50	Notes and Def	initions for this Report:
Trichloroethene	ND	0.50		
Toluene	99	0.50	EXTRACTED:	
Tetrachloroethene	ND	0.50	DATE RUN:	12/22/89
Chlorobenzene	ND	0.50	ANALYST:	<u>112</u>
Ethylbenzene	4	0.50	INSTRUMENT:	LSC 2000
p-Xylene	14	0.50	DIL. FACTOR:	1
o-Xylene	5	0.50		
Stryene	ND	0.50		
Isopropylbenzene	ND	0.50	ND = not dete	cted at detection limit
Bromobenzene	ND.	0.50		
N-Propylbenzene	ND	0.50		
2-Chlorotoluene	ND	0.50		
m-Xylene	ND	0.50		
4-Chlorotoluene	ND	0.50		
1,3,5-Trimethylbenzene	8	0.50		
T-Butylbenzene	ND	0.50		
1,2,4-Trimethylbenzene	ND	0.50		
S-Butylbenzene .	ND	0.50		
1,3-Dichlorobenzene	ND	0.50		
1,4-Dichlorobenzene	ND	0.50		
4-Isopropyltoluene	ND	0.50		
1,2-Dichlorobenzene	ND	0.50		
N-Butylbenzene	ND	0.50		
1,2,4-Trichlorobenzene	ND	0.50		
Napthalene	ND	0.50		
Hexachlorobutadiene	ND.	0.50		•
1,2,3-Trichtorobenzene	ND	0.50		

Page 19	TOXIKON CORP.	REPORT	Work Order # 89-12-166
Received: 12/16/89	Resul ts	by Sample	
SAMPLE ID OBG-2	SAMPLE # 1	3 FRACTIONS: A	
	Date & Tim	e Collected <u>12/15/89</u>	Category WATER
	. - ·		
TPH_IR625			, - -
mg/L DL=1			
1			

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TOXIKON CORP.

REPORT

Work Order # 89-12-166

Received: 12/16/89

Results by Sample

SAMPLE ID OBG-Z FRACTION 14A TEST CODE 503 NAME <u>VOLATILE HALOCARBONS</u>

Date & Time Collected 12/15/89 Category <u>MATER</u>

	RESULT	LIMIT	UNITS	= ug/i.
Benzene	32080	0.50	Notes and Def	initions for this Report:
Trichloroethene	ND	0.50		•
Toluene	33580	0.50	EXTRACTED:	
Tetrachloroethene	ND	0.50	DATE RUN:	12/22/89
Chlorobenzene	ND	0.50	ANALYST:	112
Ethylbenzene	110100	0.50	INSTRUMENT:	LSC 2000
p-Xylene	17500	0.50	DIL. FACTOR:	50
o-Xylene	7700	0.50		
Stryene	ND	0.50		
Isopropylbenzene	ND	0.50	ND = not dete	cted at detection limit
8 romobenzene	ND	0.50		
N-Propylbenzene	2610	0.50		
2-Chiorotoluene	ND.	0.50		
m-Xylene	ND	0.50		
4-Chiorotoluene	ND	0.50		
1,3,5-Trimethylbenzene	21720	0.50		
T-Butylbenzene	5950	0.50		
1,2,4-Trimethylbenzene	ND	0.50		
S-Butylbenzene	ND	0.50		
1,3-Dichloroberzene	NO	0.50		
1,4-Dichlorobenzene	ND	0.50		
4-Isopropyltaluene	ND	0.50		
1,2-Dichtorobenzene	MD	0.50		
N-Butyl benzene	MD	0.50		
1,2,4-Trichtorobenzene	ND	0.50		
Napthal ene	NO	0.50	•	
Rexach Lorobutadiene	2680	0.50		
1,2,3-Trichtorobenzene	ND	0.50		

TOXIKON CORP.

REPORT

Work Order # 89-12-166

Received: 12/16/89

Results by Sample

SAMPLE ID C8-4 FRACTION 15A TEST CODE 503 NAME <u>VOLATILE HALOCARBONS</u>

Date & Time Collected 12/15/89 Category <u>MATER</u>

	RESULT	LIMIT	UNITS = ug/L
Senzene	107	0.50	Notes and Definitions for this Report:
Trichloroethene	ND	0.50	
Toluene	99	0.50	EXTRACTED:
Tetrachloroethene	ND	0.50	DATE RUN: 12/26/89
Chiorobenz ene	ND ND	0.50	ANALYST: 445
Ethylbenzene	3	0.50	INSTRUMENT: LSC 2000
p-Xylene	13	0.50	DIL. FACTOR:1
o-Xylene	5	0.50	
Stryene	ND	0.50	
Isopropylbenzene	MD	0.50	ND = not detected at detection limit
Bramo banzene	ND	0.50	
N-Propylbenzene	ND	0.50	
2-Chiorotoluene	ND	0.50	
m-Xylene	ND	0.50	
4-Chlorotoluene	ND.	0.50	
1,3,5-Trimethylbenzene	7	0.50	
T-Butylbenzene	NO	0.50	
1,2,4-Trimethylbenzene	ND	0.50	
\$-Butylbenzene	ND	0.50	
1,3-Dichlorobenzene	ND	0.50	
1,4-Dichlorobenzene	ND	0.50	
4-Isopropyltoluene	ND	0.50	
1,2-Dichtorobenzene	NO	0.50	
N-Butylbenzene	<u>ND</u>	0.50	
1,2,4-Trichlorobenzene	ND	0.50	
Napthal ene	ND	0.50	
Kexachi orobutadiene	MD	0.50	
1,2,3-Trichlorobenzene	ND	0.50	

Page 22	TOXIKON CORP.	REPORT	Work Order # 89-12-166
Received: 12/16/89	Results	by Sample	
SAMPLE ID CB-4	SAMPLE #	16 FRACTIONS: A	
<u> </u>	Date & Tir	me Collected <u>12/15/89</u>	Category <u>WATER</u>
TPH_IR4.9			
mg/L DL=1			
SAMPLE ID CB-1B	SAMPLE #	17 FRACTIONS: A	
1	Date & Tir	me Collected <u>12/15/89</u>	Category <u>WATER</u>
TPH_IR21.8			·
mg/L DL=1			

TOXIKON CORP.

REPORT

Work Order # 89-12-166

Received: 12/16/89

Results by Sample

SAMPLE ID CB-1B

FRACTION 18A TEST CODE 503 NAME VOLATILE HALOCARBONS

Date & Time Collected 12/15/89 Category WATER

	RESULT	LIMIT	UNITS	= ug/L
Benzene	800	0.50	Notes and Defi	initions for this Report:
Trichloroethene	ND	0.50		
Toluene	661	0.50	EXTRACTED:	
Tetrachloroethene	ND	0.50	DATE RUN:	12/22/89
Chlorobenzene	ND	0.50	ANALYST:	112
Ethylbenzene	308	0.50	INSTRUMENT:	LSC 2000
p-Xylene	49	0.50	DIL. FACTOR:	1
o-Xylene	136	0.50		
Stryene	ND	0.50		
Isopropylbenzene	ND	0.50	ND = not detec	ted at detection limit
Bromobenzene	ND	0.50		
N-Propylbenzene	ND	0.50		
2-Chlorotoluene	ND	0.50		
m-Xylene	ND	0.50		
4-Chlorotoluene	ND	0.50		
1,3,5-Trimethylbenzene	58	0.50		
T-Butylbenzene	37	0.50		
1,2,4-Trimethylbenzene	ND	0.50		
S-Butylbenzene	ND	0.50		
1,3-Dichlorobenzene	ND	0.50		
1,4-Dichlorobenzene	ND.	0.50		
4-Isopropyltoluene	ND	0.50		
1,2-Dichlorobenzene	ND	0.50		
N-Butylbenzene	35	0.50		
1,2,4-Trichlorobenzene	ND	0.50		
Napthalene	ND	0.50		
Hexachlorobutadiene	ND	0.50		
1,2,3-Trichlorobenzene	ND	0.50		

Page 24 Received: 12/16/89	TOXIKON CORP.	REPORT by Sumple	Work Order # 89-12-166
RECEIVED. 12/10/07	NCOU, CO	o, salpte	
SAMPLE ID CB-1A	SAMPLE # 1	P FRACTIONS: A	
	Date & Tim	e Collected <u>12/15/89</u>	Category WATER
TPH_IR19.2			
mg/L DL=1:			

TOXIKON CORP.

REPORT

Work Order # 89-12-166

Received: 12/16/89

SAMPLE ID CB-1A	FRACTION 20A	TEST CODE 503	NAME VOLATILE HALOCARBONS
	Date & Time Col	lected <u>12/15/89</u>	Category WATER

	RESULT	LIMIT	UNITS	= ug/L
Benzene	40	0.50	Notes and Defi	nitions for this Report:
Trichloroethene	ND	0.50		The second control weeks
Toluene	41	0.50	EXTRACTED:	
Tetrachloroethene	ND	0.50	DATE RUN:	12/22/89
Chlorobenzene	ND	0.50	ANALYST:	JJS
Ethylbenzene	1	0.50	INSTRUMENT:	LSC 2000
p-Xylene	4	0.50	DIL. FACTOR:	1
o-Xylene	2	0.50		
Stryene	ND	0.50		
Isopropylbenzene	ND	0.50	ND = not detec	ted at detection limit
Bromobenzene	ND	0.50		
N-Propylbenzene	ND	0.50		
2-Chlorotoluene	ND	0.50		
m-Xylene	ND	0.50		
4-Chlorotoluene	ND.	0.50		
1,3,5-Trimethylbenzene	ND	0.50		
T-Butyl benzene	ND	0.50		
1,2,4-Trimethylbenzene	ND	0.50		
S-Butylbenzene	ND	0.50		
1,3-Dichlorobenzene	ND	0.50		
1,4-Dichlorobenzene	ND	0.50		
4-Isopropyltoluene	ND	0.50		
1,2-Dichlorobenzene	ND	0.50		
N-Butyl benzene	ND	0.50		
1,2,4-Trichlorobenzene	ND	0.50		
Napthalene	ND	0.50		
Hexachlorobutadiene	ND.	0.50		
1,2,3-Trichlorobenzene	ND	0.50		

TOXIKON CORP.

REPORT

Work Order # 89-12-166

Received: 12/16/89

Results by Sample

SAMPLE ID CB-7

FRACTION <u>21A</u> TEST CODE <u>503</u> NAME <u>VOLATILE HALOCARBONS</u>

Date & Time Collected <u>12/15/89</u> Category <u>WATER</u>

	RESULT	LIMIT	UNITS	= ug/L
Benzene	ND	0.50	Notes and Def	initions for this Report:
Trichloroethene	ND	0.50		The state of the s
Toluene	ND	0.50	EXTRACTED:	
Tetrachloroethene	ND	0.50	DATE RUN:	12/22/89
Chlorobenzene	ND	0.50	ANALYST:	JJS
Ethylbenzene	ND	0.50	INSTRUMENT:	LSC 2000
p-Xylene	ND	0.50	DIL. FACTOR:	1
o-Xylene	ND	0.50		
Stryene	ND	0.50		
Isopropylbenzene	ND	0.50	ND = not detec	eted at detection limit
Bromobenzene	ND	0.50		
N-Propylbenzene	ND	0.50		
2-Chlorotoluene	ND	0.50		
m-Xylene	ND.	0.50		
4-Chlorotoluene	ND	0.50		
1,3,5-Trimethylbenzene	ND	0.50		
T-Butylbenzene	ND	0.50	•	
1,2,4-Trimethylbenzene	ND	0.50		
S-Butylbenzene	ND	0.50		
1,3-Dichlorobenzene	ND	0.50		
1,4-Dichlorobenzene	ND	0.50		
4-Isopropyltoluene	ND	0.50		
1,2-Dichlorobenzene	ND	0.50		
N-Butylbenzene	ND	0.50		
1,2,4-Trichlorobenzene	ND	0.50		
Napthalene	ND	0.50		
Hexachlorobutadiene	ND	0.50		
1,2,3-Trichlorobenzene	ND	0.50		

TOXIKON CORP.

REPORT

Work Order # 89-12-166

Received: 12/16/89

Results by Sample

SAMPLE ID TRIP BLANK

FRACTION 23A TEST

TEST CODE 503 NAME VOLATILE HALOCARBONS

Date & Time Collected 12/15/89

Category WATER

	RESULT	LIMIT	UNITS	= ug/L
Benzene	ND	0.50	Notes and Def	initions for this Report:
Trichloroethene	ND	0.50		
Toluene	ND	0.50	EXTRACTED:	
Tetrachloroethene	ND	0.50	DATE RUN:	12/26/89
Chlorobenzene	ND	0.50	ANALYST:	112
Ethylbenzene	ND	0.50	INSTRUMENT:	LSC 2000
p-Xylene	ND	0.50	DIL. FACTOR:	1
o-Xylene	ND.	0.50		
Stryene	ND	0.50		
Isopropylbenzene	ND	0.50	ND = not detec	cted at detection limit
Bromobenzene	ND	0.50		
N-Propylbenzene	ND	0.50		
2-Chlorotoluene	ND	0.50		
m-Xylene	ND	0.50		
4-Chlorotoluene	ND	0.50		
1,3,5-Trimethylbenzene	ND	0.50		
T-Butyl benzene	ND.	0.50		
1,2,4-Trimethylbenzene	ND	0.50		
\$-Butylbenzene	ND	0.50		
1,3-Dichlorobenzene	ND	0.50		
1,4-Dichlorobenzene	ND	0.50		
4-Isopropyltoluene	ND	0.50		
1,2-Dichlorobenzene	ND	0.50		
N-Butylbenzene	ND	0.50		
1,2,4-Trichlorobenzene	ND	0.50		
Napthalene	ND	0.50		
Hexachlorobutadiene	ND	0.50		
1,2,3-Trichlorobenzene	ND	0.50		

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TOXIKON CORP.

REPORT

Work Order # 89-12-166

Received: 12/16/89

Results by Sample

SAMPLE ID OBG	2	SAMPLE # 24	FRACTIONS: A	
		Date & Time	Collected <u>12/15/89</u>	Category <u>WATER</u>
FE <u>110</u>	0 HARDNE 280	MN 5.86	T_EX_W_12/21/89	
mg/L DL=0.00	7 mg/L, DL=1.0	mg/L DL=0.002	NONE	

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TOXIKON CORP.

REPORT

Work Order # 89-12-166

Received: 12/16/89

Test Methodology

TEST CODE 503 NAME VOLATILE HALOCARBONS

EPA Method: 503

Reference: Test Methods for Evaluating Solid Waste: Physical/Chemical

Methods. EPA SW-846 (Third Edition) 1986.

Office of Solid Waste, USEPA.

TEST CODE 8010 NAME PURGEABLE HALOCARBONS SOIL

EPA Method: 8010

Reference: Test Methods for Evaluating Solid Waste: Physical/Chemical

Methods. EPA SW-846 (Third Edition) 1986.

Office of Solid Waste, USEPA.

TEST CODE 8020 NAME PURGEABLE AROMATICS SOIL

EPA Method 8020: Volatile Aromatic Compounds

Reference: Test Methods for Evaluating Solid Waste: Physical/Chemical

Methods. EPA SW-846 (Third Edition) 1986.

Office of Solid Waste, USEPA.

TEST CODE FOFPS NAME FUEL OIL FINGERPRINT (S)

EPA METHOD: D3710

Reference: Methods for Organic Chemical Analysis of Municipal and

Industrial Wastewater. Appendix A. 40CFR Part 136.

Federal Register Vol. 49, No. 209, 1984.

TEST CODE FOFPW NAME FUEL OIL FINGERPRINT (W)

EPA METHOD: D3710

Reference: Methods for Organic Chemical Analysis of Municipal and

Industrial Wastewater. Appendix A. 40CFR Part 136.

Federal Register Vol. 49, No. 209, 1984.

TEST CODE HARDNE NAME TOTAL HARDNESS

EPA METHOD: 130.2

Reference: Methods for Chemical Analysis of Water and Wastes.

EPA 600/4-79-020 (Revised, March 1983). EPA/EMSL.

TOXIKON CORP.

REPORT

Work Order # 89-12-166

Received: 12/16/89

Test Methodology

TEST CODE THE IR NAME THE BY IR

EPA METHOD: 418.1 for water sample.

Reference: Methods for Chemical Analysis of Water and Wastes.

EPA 600/4-79-020 (Revised, March 1983). EPA/EMSL, Cincinnati, OH.

EPA METHOD: 9071 for soil sample.

Reference: Test Methods for Evaluating Solid Waste: Physical/Chemical Methods.

EPA SW-846 (Third Edition) 1986. Office of Solid Waste, USEPA.

TEST CODE T EX W NAME TOTAL EXTRACTION

EPA METHOD: 3010 for Metals Preparation

200.7 - ICP for Metals Analysis (except Hg)

245.5 - Cold Vapor for Hg Analysis

Reference: Methods for Chemical Analysis of Water and Wastes.

EPA 600/4-79-020 (Revised, March 1983). EPA/EMSL, Cincinnati, OH.

raye		IOXIKOM (JUNEP.	REPORT	Work Order # 89-12-193
Received	: 12/19/89		01/02/	90 11:04:34	
REPORT	O'BRIEN & GERE		PREPARED	TOXIKON CORPORATION	
				225 WILDWOOD AVE.	0100
	BOSTON, MA 02110			WOBURN, MA 01801	Ishul Toulyna
					CERTIFIED BY
ATTEN	MARK RANDAZZO	,, .	ATTEN	PAUL LEZBERG	
			PHONE	(617) 933-6903	CONTACT JIM
CLIENT	OBRIEN GERE SA	MPLES 8			•
COMPANY	O'BRIEN & GERE		DEGE MASS	. CERT. STATUS: TRACE	METALS, FLUORIDE, CORROSIVITY
FACILITY			SERIES, S	SODIUM, T. COLIFORM(MF),	METALS, MINERALS, VOLATILE
			HALOCARBO	ONS & AROMATIC, CYANIDE,	PHENOLICS, F. COLIFORM(MF)
			STD. PLAT	E COUNT, NUTRIENTS, PES	TICIDES, O & G. TRIHALOMETHANE
	GROTON SUB BASE				
TAKEN					
TRANS					
TYPE					
INVOICE	under separate cover				
	E IDENTIFICATION			TEST CODES and NAMES u	sed on this report
				HALOCARBONS	
				RDNESS	
				<u>E</u>	
				R	
		1 EX W	TOTAL EX	TRACTION	
07 <u>08G-5</u> 08 TRIP 8					
UC) IRIP H	LI MINIS				

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TOXIKON CORP.

REPORT

Work Order # 89-12-193

Received: 12/19/89

Results by Sample

SAMPLE ID OBG-6

FRACTION DIA TEST CODE 503

TEST CODE 503 NAME VOLATILE HALOCARBONS

Date & Time Collected 12/18/89

Category WATER

	RESULT	LIMIT	UNITS = ug/L	
Benzene	1210	_0.50	Notes and Def	initions for this Report:
Trichloroethene	ND ND	0.50	notes and bei	micross for this keport:
Toluene	250	0.50	EXTRACTED:	
Tetrachloroethene	ND	0.50	DATE RUN:	12/26/89
Chlorobenzene	ND	0.50	ANALYST:	112
Ethylbenzene	400	0.50	INSTRUMENT:	LSC 2000
p-Xylene	550	0.50	DIL. FACTOR:	10
o-Xylene	130	0.50		
Stryene	ND	0.50		
Isopropylbenzene	ND	0.50	ND = not detec	ted at detection limit
Bromobenzene	ND	0.50		•
N-Propylbenzene	ND	0.50		
2-Chlorotoluene	ND	0.50		
m-Xylene	ND	0.50		
4-Chlorotoluene	ND	0.50		
1,3,5-Trimethylbenzene	ND	0.50		
T-Butylbenzene	ND	0.50		
1,2,4-Trimethylbenzene	ND	0.50		
S-Butylbenzene	ND	0.50		
1,3-Dichlorobenzene	ND	0.50		
1,4-Dichlorobenzene	ND	0.50		
4-Isopropyltoluene	ND	0.50		
1,2-Dichlorobenzene	ND	0.50		
N-Butylbenzene	ND	0.50		
1,2,4-Trichlorobenzene	ND	0.50		
Napthalene	ND	0.50		
Hexachlorobutadiene	ND	0.50		
1,2,3-Trichlorobenzene	ND	0.50		

Page 3	TOXIKOW CORP.	REPORT	Work Order # 89-12-193
Received: 12/19/89	Result		
SAMPLE ID OBG-6	SAMPLE #	02 FRACTIONS: A	
	Date & T	ime Collected <u>12/18/8</u>	Category WATER
TPH_IR	.		
mg/L DL=1			
i			

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TOXIKON CORP.

REPORT

Work Order # 89-12-193

Received: 12/19/89

SAMPLE ID OBG-3	FRACTION 03A	TEST CODE 503	NAME VOLATILE HALOCARBONS
	Date & Time Co	llected <u>12/18/89</u>	Category WATER

	RESULT	LIMIT	UNITS	= ug/L
Benzene	ND	0.50	Notes and Def	initions for this Report:
Trichloroethene	ND	0.50		merono roi ema report.
Toluene	ND	0.50	EXTRACTED:	
Tetrachloroeth ene	ND	0.50	DATE RUN:	12/26/89
Chlorobenzene	ND	0.50	ANALYST:	JJS
Ethylbenzene	ND	0.50	INSTRUMENT:	LSC 2000
p-Xylene	ND	0.50	DIL. FACTOR:	1
o-Xylene	ND	0.50		
Stryene	ND	0.50		
Isopropylbenzene	ND	0.50	ND = not deter	cted at detection limit
Bromobenzene	ND	0.50		
N-Propylbenzene	ND	0.50		
2-Chlorotoluene	ND	0.50		
m-Xylene	ND	0.50		
4-Chlorotoluene	ND	0.50		
1,3,5-Trimethylbenzene	ND	0.50		
T-Butylbenzene	ND.	0.50		
1,2,4-Trimethylbenzene	ND	0.50		
S-Butylbenzene	ND.	0.50		
1,3-Dichtorobenzene	ND	0.50		
1,4-Dichlorobenzene	ND	0.50		
4-Isopropyltoluene	ND	0.50		
1,2-Dichlorobenzene	ND	0.50		
N-Butyl benzene	ND	0.50		
1,2,4-Trichlorobenzene	ND	0.50		
Napthalene	ND	0.50		
Hexachlorobutadiene	ND.	0.50		
1,2,3-Trichlorobenzene	ND	0.50		

Page 5 Received: 12/19/89	TOXIKON CORP. Results i	REPORT by Sample	Work Order # 89-12-193
SAMPLE ID OBG-3		FRACTIONS: A	
	Date & Time	e Collected <u>12/18/89</u>	Category WATER
TPH_IRND mg/L DL=1			
}			·

TOXIKON CORP.

REPORT

Work Order # 89-12-193

Received: 12/19/89

Results by Sample

SAMPLE ID OBG-5

FRACTION <u>05A</u> TEST CODE <u>503</u> NAME <u>VOLATILE HALOCARBONS</u>

Date & Time Collected 12/18/89

Category WATER

	RESULT	LIMIT	UNITS	= ug/L
Benzene	ND	0.50	Notes and Def	initions for this Report:
Trichloroethene	ND	0.50		
Toluene	ND	0.50	EXTRACTED:	
Tetrachloroethene	ND	0.50	DATE RUN:	<u>12/26/89</u>
Chlorobenzene	ND	0.50	ANALYST:	<u>JJS</u>
Ethylbenzene	ND	0.50	INSTRUMENT:	LSC 2000
p-Xylene	ND	0.50	DIL. FACTOR:	1
o-Xylene	ND.	0.50		
Stryene	ND	0.50		
Isopropylbenzene	ND	0.50	ND = not detec	cted at detection limit
Bromobenzene	ND	0.50		
N-Propylbenzene	ND.	0.50		
2-Chloroteluene	ND	0.50		
m-Xylene	ND	0.50		
4-Chlorotoluene	ND	0.50		
1,3,5-Trimethylbenzene	ND	0.50		
T-Butylbenzene	ND	0.50		
1,2,4-Trimethylbenzene	ND	0.50		
S-Butylbenzene	ND	0.50		
1,3-Dichlorobenzene	ND	0.50		
1,4-Dichlorobenzene	ND	0.50		
4-Isopropyltoluene	ND	0.50		
1,2-Dichlorobenzene	ND	0.50		
N-Butylbenzene	ND.	0.50		
1,2,4-Trichlorobenzene	ND	0.50		
Napthal <i>e</i> ne	ND	0.50		
Hexachlorobutadiene	ND	0.50		
1,2,3-Trichlorobenzene	ND	0.50		

age r	iux	KON CORP.	REPORT	Work Order # 89-12-193	
Received: 12/19/89	?	Results by	y Sample		
SAMPLE ID OBG-5		SAMPLE # <u>06</u>	FRACTIONS: A		
		Date & Time	Collected <u>12/18/89</u>	Category WATER	
TPH_IRND					
mg/L					
SAMPLE ID OBG-5		SAMPLE # <u>07</u>	FRACTIONS: A		
l		Date & Time	Collected <u>12/18/89</u>	Category WATER	
FE103.0	HARDNE 460	MW 2.96	T_EX_W_12/21/89		
mg/L DL=0.007	mg/L, DL=1.0	mg/L DL=0.002	NONE		

TOXIKON CORP.

REPORT

Work Order # 89-12-193

Received: 12/19/89

Results by Sample

SAMPLE ID TRIP BLANK

FRACTION 08A TEST CODE 503 NAME VOLATILE HALOCARBONS

Date & Time Collected 12/18/89

Category WATER

	RESULT	LIMIT	UNITS = ug/L	
Benzene	, ND	0.50	Notes and Def	initions for this Report:
Trichloroethene	ND	0.50	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	metals for this report.
Toluene	ND	0.50	EXTRACTED:	
Tetrachloroethene	ND	0.50	DATE RUN:	12/26/89
Chlorobenzene	ND	0.50	ANALYST:	712
Ethylbenzene	ND	0.50	INSTRUMENT:	LSC 2000
p-Xylene	ND	0.50	DIL. FACTOR:	1
o-Xylene	ND	0.50		
Stryene	ND	0.50		
Isopropylbenzene	ND	0.50	ND = not deter	cted at detection limit
Bromobenzene	ND	0.50		·
N-Propylbenzene	ND	0.50		
2-Chlorotoluene	ND	0.50		
m-Xylene	ND.	0.50		
4-Chlorotoluene	ND	0.50		
1,3,5-Trimethylbenzene	ND	0.50		
T-Butylbenzene	ND	0.50		
1,2,4-Trimethylbenzene	ND	0.50		
S-Butyl benzene	ND	0.50		
1,3-Dichlorobenzene	ND.	0.50		
1,4-Dichlorobenzene	ND	0.50		
4-Isopropyltoluene	ND	0.50		
1,2-Dichlorobenzene	ND	0.50		
N-Butylbenzene	ND	0.50		
1,2,4-Trichlorobenzene	ND	0.50		
Napthalene	ND	0.50		
Hexachlorobutadiene	ND	0.50		
1,2,3-Trichlorobenzene	ND	0.50		

TOXIKON CORP.

REPORT

Work Order # 89-12-193

Received: 12/19/89

Test Methodology

TEST CODE 503 NAME VOLATILE HALOCARBONS

EPA Method: 503

Reference: Test Methods for Evaluating Solid Waste: Physical/Chemical

Methods. EPA SW-846 (Third Edition) 1986.

Office of Solid Waste, USEPA.

TEST CODE HARDNE NAME TOTAL HARDNESS

EPA METHOD: 130.2

Reference: Methods for Chemical Analysis of Water and Wastes.

EPA 600/4-79-020 (Revised, March 1983). EPA/EMSL.

TEST CODE THE IR NAME THE BY IR

EPA METHOD: 418.1 for water sample.

Reference: Methods for Chemical Analysis of Water and Wastes.

EPA 600/4-79-020 (Revised, March 1983). EPA/EMSL, Cincinnati, OH.

EPA METHOD: 9071 for soil sample.

Reference: Test Methods for Evaluating Solid Waste: Physical/Chemical Methods.

EPA SW-846 (Third Edition) 1986. Office of Solid Waste, USEPA.

TEST CODE T EX W NAME TOTAL EXTRACTION

EPA METHOD: 3010 for Metals Preparation

200.7 - ICP for Metals Analysis (except Hg)

245.5 - Cold Vapor for Hg Analysis

Reference: Methods for Chemical Analysis of Water and Wastes.

EPA 600/4-79-020 (Revised, March 1983). EPA/EMSL, Cincinnati, OH.

Page 1		TOXIKON	CORP.	REPORT	•	lork Order # 90-01-
Received	01/09/90		01/19/	90 14:35:24		
REPORT	O'BRIEN & GERE		PREPARED	TOXIKON CORPORAT	TON	
TO	100 SUMMER ST., SUIT			225 WILDWOOD AVE		- // //.
	BOSTON, MA 02110			WOBURN, MA 01801		- dyrth
						CERTIFIED BY
ATTEN	PAUL STEINBURG		ATTEN	PAUL LEZBERG		
			PHONE	(617) 933-6903		CONTACT JIM
CLIENT	OBRIEN GERE S	AMPLES 3				
COMPANY	O'BRIEN & GERE		DEQE MAS	S. CERT. STATUS:	TRACE META	LS, FLUORIDE, CORROS
FACILITY						LS, MINERALS, VOLA
						OLICS, F. COLIFORM
			STD. PLAT	TE COUNT, NUTRIEN	IS. PESTICID	ES, O & G, TRIHALON
WORK ID	NAUFAC SUB BASE, NEW	LONDON		$\mathcal{M} \cdot \mathcal{M}$	1 6 7	, ∔∮
TAKEN			QA MANAGI	er: MI Chan	J . C	suth.
TRANS	s)	
	WATER		Previous	ly Reported on 01	/18/90.	
			First Re	oorted on 01/18/9	0.	
INV. #	5179					

Page 2 Received: 01/09/90	TOXIKON CORP. Results b	REPORT by Sample	Work Order # 90-01-063
SAMPLE ID CB-4		TEST CODE FOFPW collected 01/08/90	NAME FUEL OIL FINGERPRINT (W) Category WATER
	RESULT	UNITS = Qualita	tive
GASOLINE		PRESENT	
KEROSENE		PRESENT	
DIESIL FUEL		PRESENT	
NO. 2 FUEL OIL	•	ND	
NO. 4 FUEL OIL	 	ND ND	
NO. 6 FUEL OIL		ND ND	
PETROLEUM CONTAMINANT N.O	.s	<u>ND</u>	

Notes and Definitions for this Report:

EXTRACTED: 01/15/90
DATE RUN: 01/17/90
ANALYST: ADD
INSTRUMENT: G-4
DIL. FACTOR: 10

ND = NOT DETECTED AT DETECTION LIMIT

N.O.S. = NOT OTHERWISE SPECIFIED

QUALITATIVE DETECTION LIMIT = 1 PPB

TOXIKON CORP.

REPORT

Work Order # 90-01-063

Received: 01/09/90

Results by Sample

SAMPLE ID OF-1	FRACTION 02A	TEST CODE 503	NAME VOLATILE HALOCARBONS
	Date & Time Co	lected <u>01/08/90</u>	Category WATER

	RESULT	LIMIT	UNITS = ug/L
Benzene	ND.	0.50	Notes and Definitions for this Report:
Trichloroethene	ND	0.50	
Toluene	ND	0.50	EXTRACTED:
Tetrachloroethene	ND	0.50	DATE RUN: 01/16/90
Chlorobenzene	ND	0.50	ANALYST: ADD
Ethylbenzene	ND	0.50	INSTRUMENT: LCS-2000
p-Xylene	ND	0.50	DIL. FACTOR: 1
o-Xylene	ND	0.50	
Stryene	ND	0.50	
Isopropylbenzene	ND	0.50	ND = not detected at detection limit
Bromobenzene	ND	0.50	
N-Propylbenzene	ND	0.50	
2-Chlorotoluene	ND.	0.50	
m-Xylene	ND	0.50	
4-Chlorotoluene	ND	0.50	
1,3,5-Trimethylbenzene	ND	0.50	
T-Butylbenzene	ND	0.50	
1,2,4-Trimethylbenzene	ND	0.50	
S-Butylbenzene	ND	0.50	
1,3-Dichlorobenzene	ND	0.50	
1,4-Dichlorobenzene	ND	0.50	
4-Isopropyltoluene	ND.	0.50	
1,2-Dichlorobenzene	ND	0.50	
N-Butylbenzene	ND	0.50	
1,2,4-Trichlorobenzene	ND	0.50	
Napthalene	ND	0.50	
Hexachlorobutadiene	ND	0.50	
1,2,3-Trichlorobenzene	ND	0.50	

Page 4 TOXIKON CORP. Received: 01/09/90

Work Order # 90-01-063

Results	by	Sample	•
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SAMPLE ID OF-1	SAMPLE # 03 FRACTIONS: A
	Date & Time Collected <u>01/08/90</u> Category <u>WATER</u>
TPH_IRND mg/L, DL=1.0	

TOXIKON CORP.

REPORT

Work Order # 90-01-063

Received: 01/09/90

Test Methodology

TEST CODE 503 NAME VOLATILE HALOCARBONS

EPA Method: 503

Reference: Test Methods for Evaluating Solid Waste: Physical/Chemical

Methods. EPA SW-846 (Third Edition) 1986.

Office of Solid Waste, USEPA.

TEST CODE FOFPW NAME FUEL OIL FINGERPRINT (W)

EPA METHOD: D3710

Reference: Methods for Organic Chemical Analysis of Municipal and

Industrial Wastewater. Appendix A. 40CFR Part 136.

Federal Register Vol. 49, No. 209, 1984.

TEST CODE THE IR NAME THE BY IR

EPA METHOD: 418.1 for water sample.

Reference: Methods for Chemical Analysis of Water and Wastes.

EPA 600/4-79-020 (Revised, March 1983). EPA/EMSL, Cincinnati, OH.

EPA METHOD: 9071 for soil sample.

Reference: Test Methods for Evaluating Solid Waste: Physical/Chemical Methods.

EPA SW-846 (Third Edition) 1986. Office of Solid Waste, USEPA.

Page 1	TOXIKON	CORP. REPORT	Work Order # 90-06-257
_	06/27/90	07/11/90 13:04:34	
REPORT	O'BRIEN & GERE ENGINEERS, INC.	PREPARED TOXIKON CORPORATION	
	100 SUMMER ST., SUITE 2904		
	BOSTON, MA. 02110	WOBURN, MA 01801	/ Our hegien,
			CERTIFIED BY
ATTEN	ED ZIMMERMAN	ATTEN PAUL LEZBERG	·
		PHONE (617) 933-6903	CONTACT JIM
CLIENT	O BRIEN GERE SAMPLES 17		
COMPANY	C'BRIEN & GERE ENGINEERS, INC.	DEQE MASS. CERT. STATUS: TRAC	E METALS, FLUORIDE, CORROSIVITY
FACILITY	100 SUMMER ST., SUITE 2904	SERIES, SODIUM, T. COLIFORM(MF)	, METALS, MINERALS, VOLATILE
171012111	BOSTON, MA. 02110		, PHENOLICS, F. COLIFORM(MF)
		STD. PLATE COUNT, MUTRIENTS, PE	STICIDES, O & G, TRIHALOMETHANE
WORK ID	NAVAL GROTON, CT.		
	6/25/90 THROUGH 6/27/90		
	SOIL AND WATER		
		•	
	under separate cover	•	
11170102		•	•
SAMPL	E IDENTIFICATION	TEST CODES and NAMES	used on this report
		VOLATILE HALOCARBONS	
		PURGEABLE HALOCARBONS SOIL	
		PURGEABLE AROMATICS SOIL	
		S FUEL OIL FINGERPRINT	
05 MW-8		NE TOTAL HARDNESS	
06 MW-9		TW METALS, TOTAL EXT., WATER	
07 MW-9		MANGANESE	
08 MW-9		IR TPH BY IR	
11 MW-8			
13 MW-9			
14 MW-9			
15 MW-9			
16 SPIKE			
17 TRIP			

Work Order # 90-06-257 Page 2 TOXIKON CORP. Received: 06/27/90 Results by Sample SAMPLE # 01 FRACTIONS: A SAMPLE ID MW-7 Date & Time Collected 06/27/90 11:00:00 Category WATER TPH_IR_ mg/L DL=1.0 SAMPLE # 02 FRACTIONS: A SAMPLE ID MW-8 Date & Time Collected 06/27/90 11:15:00 Category WATER TPH_IR__ mg/L DL=1.0 SAMPLE ID MU-9 SAMPLE # 03 FRACTIONS: A Date & Time Collected 06/27/90 11:15:00 Category WATER

TPH_IR___

mg/L DL=1.0

TOXIKON CORP.

REPORT

Work Order # 90-06-257

Received: 06/27/90

Results by Sample

SAMPLE ID NU-7 FRACTION 04A TEST CODE 503 NAME VOLATILE HALOCARBONS

Date & Time Collected 06/27/90 10:45:00 Category WATER

	RESULT	LIMIT	UNITS = ug/L	
Benzene	ND	0.50	Notes and Defi	initions for this Report:
Trichloroethene	ND	0.50		
Toluene	3	0.50	EXTRACTED:	
Tetrachloroethene	ND.	0.50	DATE RUN:	07/03/90
Chlorobenzene	ND	0.50	ANALYST:	<u>MG</u>
Ethylbenzene	ND	0.50	INSTRUMENT:	LSC 2000
p-Xylene	ND.	0.50	DIL. FACTOR:	<u>_</u> 1
o-Xylene	ND.	0.50		
Stryene	ND	0.50		
Isopropylbenzene	ND	0.50	ND = not detec	cted at detection limit
Bromobenzene	5	0.50		
N-Propylbenzene	ND	0.50		
2-Chlorotoluene	ND	0.50		
m-Xylene	ND	0.50		
4-Chlorotoluene	ND	0.50		•
1,3,5-Trimethylbenzene	ND	0.50		
T-Butylbenzene	ND	0.50		
1,2,4-Trimethylbenzene	ND	0.50		
S-Butylbenzene	ND	0.50		
1,3-Dichlorobenzene	ND	0.50		
1,4-Dichlorobenzene	<u>ND</u>	0.50		
4-Isopropyltoluene	ND	0.50		
1,2-Dichlorobenzene	ND	0.50		
N-Butylbenzene	ND	0.50		
1,2,4-Trichlorobenzene	ND	0.50		
Napthalene	ND	0.50		
Hexachlorobutadiene	ND	0.50		
1,2,3-Trichlorobenzene	ND	0.50		

TOXIKON CORP.

REPORT

Work Order # 90-06-257

Received: 06/27/90

Results by Sample

SAMPLE ID MW-8 FRACTION 05A TEST CODE 503 NAME VOLATILE HALOCARBONS
Date & Time Collected 06/27/90 11:00:00 Category WATER

	RESULT	LIMIT	UNITS	= ug/L
Benzene	ND	0.50	Notes and Defi	nitions for this Report:
Trichloroethene	ND	0.50		
Toluene	ND	0.50	EXTRACTED:	
Tetrachloroethene	<u>ND</u>	0.50	DATE RUN:	07/03/90
Chlorobenzene	<u>ND</u>	0.50	ANALYST:	MG
Ethylbenzene	ND	0.50	INSTRUMENT:	LSC 2000
p-Xylene	ND	0.50	DIL. FACTOR:	1
o-Xylene	ND.	0.50		
Stryene	ND	0.50		
1 sopropylbenzene	ND.	0.50	ND = not detec	ted at detection limit
Bromobenzene	<u>ND</u>	0.50		
N-Propylbenzene	<u>ND</u>	0.50		
2-Chlorotoluene	ND	0.50		
m-Xylene	<u>ND</u>	0.50		
4-Chlorotoluene	ND	0.50		
1,3,5-Trimethylbenzene	ND.	0.50		
T-Butylbenzene	ND.	0.50		
1,2,4-Trimethylbenzene	ND	0.50		
S-Butylbenzene	ND	0.50		
1,3-Dichlorobenzene	ND	0.50		
1,4-Dichlorobenzene	ND	0.50		
4-Isopropyltoluene	ND.	0.50		
1,2-Dichlorobenzene	ND	0.50		
N-Butylbenzene	ND	0.50		
1,2,4-Trichlorobenzene	ND	0.50		
Napthalene	ND	0.50		
Hexachlorobutadiene	ND	0.50		
1,2,3-Trichlorobenzene	ND	0.50		

TOXIKON CORP.

REPORT

Work Order # 90-06-257

Received: 06/27/90

Results by Sample

SAMPLE ID MW-9 FRACTION <u>06A</u> TEST CODE <u>503</u> NAME <u>VOLATILE HALOCARBONS</u>

Date & Time Collected <u>06/27/90 11:15:00</u> Category <u>WATER</u>

	20.00			
	RESULT	LIMIT	UNITS	= ug/L
Benzene	1000	0.50	Notes and Def	initions for this Report:
Trichloroethene	ND	0.50		
Toluene	4000	0.50	EXTRACTED:	
Tetrachloroethene	ND	0.50	DATE RUN:	07/03/90
Chlorobenzene	<u>ND</u>	0.50	ANALYST:	MG
Ethylbenzene	1300	0.50	INSTRUMENT:	LSC 2000
p-Xylene	ND	0.50	DIL. FACTOR:	20
o-Xylene	800	0.50		
Stryene	ND	0.50		
I sopropy i benzene	ND	0.50	ND = not dete	cted at detection limit
Bromobenzene	ND	0.50		
N-Propytbenzene	ND.	0.50		
2-Chlorotoluene	<u>140</u>	0.50		
m-Xylene	3000	0.50		
4-Chlorotoluene	ND	0.50		
1,3,5-Trimethylbenzene	<u>150</u>	0.50		
T-Butylbenzene	1200	0.50		
1,2,4-Trimethylbenzene	500	0.50	•	
S-Butylbenzene	ND.	0.50		
1,3-Dichlorobenzene	1600	0.50		
1,4-Dichlorobenzene	ND	0.50		
4-Isopropyltoluene	ND	0.50		
1,2-Dichlorobenzene	ND	0.50		
N-Butylbenzene	ND	0.50		
1,2,4-Trichlorobenzene	ND	0.50		
Napthalene	400	0.50		
Hexachlorobutadiene	ND	0.50		•
1,2,3-Trichlorobenzene	ND	0.50		

Page 6 Received: 06/27/90	TOXIKON CORP. Results by	REPORT Sample	Work	Order # 90-06-257
SAMPLE ID NU-9	SAMPLE # 07	FRACTIONS: A		
	Date & Time	Collected <u>06/27/9</u> 0	11:15:00	Category WATER
		_		
HARDNE 160				
mg/L DL=1.0				
SAMPLE ID MW-9	SAMPLE # <u>08</u>	FRACTIONS: A		
•	Date & Time	Collected <u>06/27/9</u>	11:15:00	Category <u>WATER</u>
MN 1.25				
mg/L DL=0.002				

TOXIKON CORP.

REPORT

Work Order # 90-06-257

Received: 06/27/90

Results by Sample

SAMPLE ID MN-7 FRACTION 09A TEST CODE 8010 NAME PURGEABLE HALOCARBONS SOIL

Date & Time Collected 06/26/90 10:00:00 Category SOIL

	RESULT	LIMIT	UNITS = ug/Kg
Chloromethane	ND	2.0	
Bromomethane	ND	2.0	
Vinyl Chloride	ND	2.0	
Dichlorodifluoromethane	ND	2.0	
Chloroethane	ND	2.0	
Methylene Chloride	ND	2.0	
Trichlorofluoromethane	ND	2.0	·
1,1-Dichloroethene	ND	2.0	
1,1-Dichloroethane	ND.	2.0	
trans-1,2-Dichloroethene	ND	2.0	
Chloroform	ND.	2.0	
1,2-Dichloroethane	ND	2.0	
1,1,1-Trichloroethane	ND.	2.0	
Carbon tetrachloride	ND	2.0	
Bromodichloromethane	ND	2.0	
1,2-Dichloropropane	ND	2.0	
Trans-1,3-Dichloropropane	ND	2.0	
Trichloroethene	ND	2.0	
cis-1,3-Dichloropropene	ND	2.0	
1,1,2-Trichloroethane	ND	2.0	
Dibromochloromethane	<u>ND</u>	2.0	
2-Chloroethylvinyl ether	<u>ND</u>	2.0	
Bromoform	ND	2.0	
1,1,2,2-Tetrachloroethane	ND.	2.0	
Tetrachloroethene	ND	<u>2.0</u>	
Chlorobenzene	ND	2.0	
1,4-Dichlorobenzene	ND	2.0	
1,3-Dichlorobenzene	ND	2.0	
1,2-Dichlorobenzene	ND	2.0	

Notes and Definitions for this Report:

ND = not detected at detection limit

Page 8	EUXTRON CORP.	KEPUKI	MOLE	Urdel # 90-00-231	
Received: 06/27/90	Resui	lts by Sample			
SAMPLE ID NU-7	FRACTION	09A TEST CODE	BO20 NAME PUR	GEABLE AROMATICS S	OIL
	Date & Ti	ime Collected <u>06/2</u>	6/90 10:00:00	Category SOIL	
	RESULT	LIMIT U	NITS = ug/Kg		
BENZENE	NI	2.0			
TOLUENE	N	2.0			
ETHYLBENZENE	N	2.0			
XYLENES (TOTAL)	<u> </u>	0 2.0			
	Notes and Defini	tions for this Rep	ort:		
•	EXTRACTED:				
	DATE RUN: 0	7/03/90			
	ANALYST:	<u>MG</u>			
	INSTRUMENT:	LSC 2			

ND = not detected at detection limit

DIL. FACTOR: ___1

Page 9 Received: 06/27/90	TOXIKON CORP. Results by	REPORT / Sample	Work Order # 90-06-257
SAMPLE ID MW-7	SAMPLE # <u>10</u>	FRACTIONS: A	
	Date & Time	Collected <u>06/26/90 10</u> :	:15:00 Category SOIL
TPH_IR526			
mg/Kg DL=40			
SAMPLE ID MJ-8	CAMDIE # 41	FRACTIONS: A	
SATELE ID HE'O		Collected <u>06/25/90 10:</u>	:00:00 Category SOIL
TPH_IR106			
mg/Kg DL≃40			

TOXIKON CORP.

REPORT

Work Order # 90-06-257

Received: 06/27/90

Results by Sample

SAMPLE ID MU-8	FRACTION 12A	TEST CODE 8010	NAME PURG	EABLE HALOCARBONS SOIL
	Date & Time Col	lected 06/25/90 09	:45:00	Category SOIL

	RESULT	LIMIT	UNITS = ug/Kg
Chloromethane	ND	2.0	
Bromomethane	ND	2.0	
Vinyl Chloride	ND	2.0	
Dichlorodifluoromethane	ND	2.0	
Chloroethane	ND	2.0	
Methylene Chloride	ND	2.0	•
Trichlorofluoromethane	ND	2.0	
1.1-Dichloroethene	ND	2.0	
1.1-Dichloroethane	ND	2.0	
trans-1,2-Dichloroethene	ND	2.0	
Chloroform	ND	2.0	
1,2-Dichloroethane	ND	2.0	
1,1,1-Trichloroethane	ND	2.0	
Carbon tetrachloride	ND	2.0	
Bromodichloromethane	ND	2.0	
1.2-Dichloropropane	ND	2.0	
Trans-1,3-Dichloropropane	ND.	2.0	
Trichloroethene	ND	2.0	
cis-1,3-Dichloropropene	ND.	2.0	
1,1,2-Trichloroethane	<u>ND</u>	<u>2.0</u>	
Dibromochloromethane	<u>ND</u>	2.0	
2-Chloroethylvinyl ether	ND	2.0	
Bromoform	ND	2.0	
1,1,2,2-Tetrachloroethane	ND	2.0	
Tetrachloroethene	ND	2.0	
Chlorobenzene	ND	2.0	
1,4-Dichlorobenzene	ND	2.0	
1,3-Dichlorobenzene	<u>ND</u>	2.0	
1,2-Dichlorobenzene	ND	2.0	

Notes and Definitions for this Report:

EXTRACTED:

DATE RUN: 07/03/90

ANALYST: MG

INSTRUMENT: LSC 2

DIL. FACTOR: 1

Page 11	TOXIKON CORP.	REPORT	MOLE	Urder # 90-00-237	
Received: 06/27/90	Resul	ts by Sample			
SAMPLE ID NW-8	FRACTION .	12A TEST CODE	8020 NAME PUR	GEABLE AROMATICS S	DIL
			25/90 09:45:00		
					
	RESULT	LIMIT	UNITS = ug/Kg		
BENZENE	ND	2.0			
TOLUENE	ND	2.0			
ETHYLBENZENE	ND	2.0			
XYLENES (TOTAL)	ND	2.0			
	Notes and Definit	ions for this R	eport:		
e.	EXTRACTED:	7/03/90			
	ANALYST: _M INSTRUMENT:	<u>1G</u> LSC_2			
	DIL FACTOR.	1			

ND = not detected at detection limit

TOXIKON CORP.

REPORT

Work Order # 90-06-257

Received: 06/27/90

Results by Sample

SAMPLE ID MW-9

FRACTION 13A TEST CODE FOFPS NAME FUEL OIL FINGERPRINT

Date & Time Collected 06/25/90 01:45:00 Category SOIL

RESULT

Units = Qualitative

GASOLINE

PRESENT

KEROSENE

NOT PRESENT

DIESEL FUEL

NOT PRESENT

NO. 2 FUEL OIL

NOT PRESENT

NO. 4 FUEL OIL

NOT PRESENT

NO. 6 FUEL OIL

NOT PRESENT

PETROLEUM CONTAMINANT N.O.S.

NOT PRESENT

Notes and Definitions for this Report:

EXTRACTED 07/05/90
DATE RUN 07/06/90

ANALYST

N.O.S. = NOT OTHERWISE SPECIFIED

Received: 06/27/90

Results by Sample

SAMPLE ID MW-9

FRACTION 15A TEST CODE 8010 NAME PURGEABLE HALOCARBONS SOIL
Date & Time Collected 06/25/90 01:00:00 Category SOIL

	RESULT	LIMIT	UNITS = ug/Kg
Chloromethane	ND	2.0	
Bromomethane	ND	2.0	
Vinyl Chloride	ND	2.0	
Dichlorodifluoromethane	ND	2.0	
Chloroethane	ND	2.0	
Methylene Chloride	ND	2.0	
Trichlorofluoromethane	ND.	_2.0	
1,1-Dichloroethene	ND	2.0	
1,1-Dichloroethane	ND	2.0	
trans-1,2-Dichloroethene	ND.	2.0	
Chloroform	ND	2.0	•
1,2-Dichloroethane	ND	2.0	
1,1,1-Trichloroethane	ND	2.0	
Carbon tetrachloride	ND.	2.0	
Bromodichloromethane	ND	2.0	
1,2-Dichloropropane	ND	2.0	
Trans-1,3-Dichloropropane	ND	2.0	
Trichloroethene	ND	2.0	
cis-1,3-Dichloropropene	ND	2.0	
1,1,2-Trichloroethane	ND	2.0	
Dibromochloromethane	ND	2.0	
2-Chloroethylvinyl ether	ND	2.0	
Bromoform	ND	2.0	
1,1,2,2-Tetrachloroethane	ND	2.0	
Tetrachloroethene	ND	2.0	
Chlorobenzene	ND	2.0	
1,4-Dichlorobenzene	ND	2.0	
1,3-Dichlorobenzene	ND	2.0	
1,2-Dichlorobenzene	ND.	2.0	

Notes and Definitions for this Report:

EXTRACTED:

DATE RUN: 07/03/90

ANALYST: MG

INSTRUMENT: LSC 2

DIL. FACTOR: 1

TOXIKON CORP.

REPORT

Work Order # 90-06-257

Received: 06/27/90

Results by Sample

SAMPLE ID MW-9

FRACTION 15A TEST CODE 8020 NAME PURGEABLE AROMATICS SOIL

Date & Time Collected <u>06/25/90 01:00:00</u>

Category SOIL

RESULT

LIMIT

UNITS = ug/Kg

BENZENE

1500 2.0

TOLUENE

1500 2.0

ETHYLBENZENE

500 2.0

XYLENES (TOTAL)

2500 2.0

Notes and Definitions for this Report:

EXTRACTED:

DATE RUN:

07/03/90

ANALYST:

10

ND = not detected at detection limit

INSTRUMENT:

LSC 2

DIL. FACTOR:

TOXIKON CORP.

REPORT

Work Order # 90-06-257

Received: 06/27/90

Results by Sample

SAMPLE ID SPIKE FRACTION 16A TEST CODE 8010 NAME PURGEABLE HALOCARBONS SOIL

Date & Time Collected 06/26/90 11:00:00 Category SOIL

	RESULT	LIMIT	UNITS = ug/Kg
Chloromethane	ND	2.0	
Bromomethane	ND	2.0	
Vinyl Chloride	ND	2.0	
Dichlorodifluoromethane	ND	2.0	
Chloroethane	ND	2.0	
Methylene Chloride	ND	2.0	
Trichlorofluoromethane	ND	2.0	
1,1-Dichloroethene	ND	2.0	
1,1-Dichloroethane	ND	2.0	
trans-1,2-Dichloroethene	ND	2.0	
Chloroform	ND	2.0	
1,2-Dichloroethane	ND	2.0	
1,1,1-Trichloroethane	ND	2.0	
Carbon tetrachloride	ND	2.0	
Bromodichloromethane	ND.	2.0	
1,2-Dichloropropane	ND	2.0	
Trans-1,3-Dichloropropane	ND	2.0	
Trichloroethene	ND	2.0	
cis-1,3-Dichloropropene	ND	2.0	
1,1,2-Trichloroethane	ND	2.0	
Dibromochloromethane	ND	2.0	
2-Chloroethylvinyl ether	ND	2.0	
Bromoform	ND	2.0	
1,1,2,2-Tetrachloroethane	ND	2.0	
Tetrachloroethene	ND.	2.0	
Chlorobenzene	ND	2.0	
1,4-Dichlorobenzene	ND	2.0	
1,3-Dichlorobenzene	ND.	2.0	
1,2-Dichlorobenzene	ND	2.0	

Notes and Definitions for this Report:

EXTRACTED:

DATE RUN:

07/03/90

ANALYST:

MG

INSTRUMENT:

LSC 2

DIL. FACTOR:

1

REPORT Work Order # 90-06-257 TOXIKON CORP. Page 17 Received: 06/27/90 Results by Sample FRACTION 16A TEST CODE 8020 NAME PURGEABLE AROMATICS SOIL SAMPLE ID SPIKE Date & Time Collected 06/26/90 11:00:00 Category SOIL UNITS = ug/Kg RESULT LIMIT BENZENE ND 2.0 TOLUENE ND 2.0 ETHYLBENZENE ND 2.0 XYLENES (TOTAL) ND 2.0 Notes and Definitions for this Report: EXTRACTED: DATE RUN: 07/03/90 ANALYST: LSC 2

ND = not detected at detection limit

INSTRUMENT: DIL. FACTOR: TOXIKON CORP.

REPORT

Work Order # 90-06-257

Received: 06/27/90

Results by Sample

SAMPLE ID TRIP BLANK

FRACTION 17A TEST CODE 503 NAME <u>VOLATILE HALOCARBONS</u>
Date & Time Collected 06/27/90 12:00:00 Category <u>WATER</u>

	RESULT	LIMIT	UNITS	= ug/L
Benzene	ND	0.50	Notes and Def	initions for this Report:
Trichloroethene	ND	0.50		
Toluene	ND	0.50	EXTRACTED:	***
Tetrachloroethene	ND	0.50	DATE RUN:	07/03/90
Chlorobenzene	ND	0.50	ANALYST:	<u>MG</u>
Ethylbenzene	ND	0.50	INSTRUMENT:	LSC 2000
p-Xylene	ND	0.50	DIL. FACTOR:	1
o-Xylene	<u>ND</u>	0.50		
Stryene	ND	0.50		
Isopropylbenzene	ND	0.50	ND = not deter	cted at detection limit
Bromobenzene	<u>ND</u>	0.50		
N-Propytbenzene	ND	0.50		
2-Chlorotoluene	ND	0.50		
m-Xylene	ND	0.50		
4-Chlorotoluene	ND	0.50		
1,3,5-Trimethylbenzene	ND	0.50		
T-Butylbenzene	ND	0.50		
1,2,4-Trimethylbenzene	<u>ND</u>	0.50		
S-Butylbenzene	ND.	0.50		
1,3-Dichlorobenzene	ND	0.50		
1,4-Dichlorobenzene	ND	0.50		
4-Isopropyltoluene	ND	0.50		
1,2-Dichlorobenzene	ND	0.50		
N-Butylbenzene	ND	0.50		
1,2,4-Trichlorobenzene	<u>ND</u>	0.50		
Napthalene	ND	0.50		
Hexachlorobutadiene	ND	0.50		•
1,2,3-Trichlorobenzene	<u>ND</u>	0.50		

TOXIKON CORP.

REPORT

Work Order # 90-06-257

Received: 06/27/90

Test Methodology

TEST CODE 503 NAME VOLATILE HALOCARBONS

EPA Method: 503

Reference: Test Methods for Evaluating Solid Waste: Physical/Chemical

Methods. EPA SW-846 (Third Edition) 1986.

Office of Solid Waste, USEPA.

TEST CODE 8010 NAME PURGEABLE HALOCARBONS SOIL

EPA Method: 8010

Reference: Test Methods for Evaluating Solid Waste: Physical/Chemical

Methods. EPA SW-846 (Third Edition) 1986.

Office of Solid Waste, USEPA.

TEST CODE 8020 NAME PURGEABLE AROMATICS SOIL

EPA Method 8020: Volatile Aromatic Compounds

Reference: Test Methods for Evaluating Solid Waste: Physical/Chemical

Methods. EPA SW-846 (Third Edition) 1986.

Office of Solid Waste, USEPA.

TEST CODE FOFPS NAME FUEL OIL FINGERPRINT

EPA METHOD: D3710

Reference: Methods for Organic Chemical Analysis of Municipal and

Industrial Wastewater. Appendix A. 40CFR Part 136.

Federal Register Vol. 49, No. 209, 1984

TEST CODE HARDNE NAME TOTAL HARDNESS

EPA METHOD: 130.2

Reference: Methods for Chemical Analysis of Water and Wastes.

EPA 600/4-79-020 (Revised, March 1983). EPA/EMSL.

TEST CODE MEX TW NAME METALS, TOTAL EXT., WATER

REFERENCE:

EPA METHOD 3005. Acid Digestion of Waters for Total Recoverable or Dissolved Metals for Analysis by Flame Atomic Absorption Spectroscopy or Inductively Coupled Plasma Spectroscopy. Test Methods for Evaluating

Physical/Chemical Methods. SW 846, 3rd Edition.

TEST CODE TPH IR NAME TPH BY IR

EPA METHOD: 418.1 for water sample.

Reference: Methods for Chemical Analysis of Water and Wastes.

TOXIKON CORP.

REPORT

Work Order # 90-06-257

Received: 06/27/90

Test Methodology

Continued From Above

TEST CODE THE IR NAME THE BY IR

EPA 600/4-79-020 (Revised, March 1983). EPA/EMSL, Cincinnati, OH.

EPA METHOD: 9071 for soil sample.

Reference: Test Methods for Evaluating Solid Waste: Physical/Chemical Methods. EPA SW-846 (Third Edition) 1986. Office of Solid Waste, USEPA.

1862.02= toxilson , CHAIN OF CUSTOOK RECORD Address 100 Summer St. BASTON MA. Todkon Project #: Clients Diguest + have Burns Phones Client Contacts Abbreviations: 1-Natur 2-Scil P-Plastic SAMPLE MOLLISIS RECOESTED F-Dlass D-VON 3-Sludge Date Due 11 20 4-011 5-Timme · 6-Other Simpled Toxikon Client Container Preservation Sumple Comments D # ID # Type Type & # ייווין איין איין TOTAL PETRAGEN HORE (EAR 11) - GUERCH But THE ZVIVAL CHAME? CO-IA MORE SAMPLE ! 1 EWE LANG SUMS (4 MU) (315 CO-10 SM ZVINS (ADOR) co-4 1250 I VIAL (40m) CB-S 1235 1 JM ZVIRS (40ML) CD-7 1330 Lome Relinquished By 1 clima Im Date/Times 1/15/89 1000 Reclaved Byr Down (links Date/Time: 11-15-89

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CEAIN OF CISTON SECTION CHAIN OF CUSTOD'S RECORD Client: O'Brien & Grete Eng Millows: 100 Summer St.
Client Contact: Mark A. Rundrezo Phone: 617-423-1919 Groton Sib Base. Abbreviations: 1-Water P-Plastic SMOTE MALYSIS RECUESTED 2-Sail G-Glass 3-Sluciae A-AOV Date Due 12/23/23 4-011 5-Timme 6-Other Toxikon Client Sample Sampled Container Preservation ID ± m 🛊 D /TT Type Type & # Comments 2/40ml 10BG-6 3:01 12/18 12:45 OBG-6 Quait Jus . 2 12/19 12:45 OBG-3. 2/40 ml П 1710 OBG-3 Quart-Tor 1:10 OB6-5 2/40 ml 4:30 OBG-5 Quart Jur 4:30 Plastic. Quest .7 036-5 4:30 Trip Blank: 1/40ml ·---V Relinquished By: Went Kingford Date/Time: 12/9/89 Reclaved Byr Wal han way Date/Time: 12/19/87

pprent:	ationa: 1-75% 2-05U	4.44	P-PLACE G-CIN	al to	ref i saar	9 - 14 -	**	e entreme.				50b	of all with	the second of th	
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	0%-45k7K)	11	16		1	1:15				X	17 m.k. 122 mg . s	State Constituti			
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a Polarit e Caracilla de la ca	This security do so is a way a	and the second of the	The state of the s	The second secon	*********	The second	THE CHOICE STREET	10 Julio			4 - W. S. T. W.	40000	totosejo airi.		
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225 Wildwood Ave., Woburn, MA 01801 Telephone: (617) 933-6903 Fax: (617) 933-9196

CHAIN OF CUSTODY RECORD

WORK ORDER #: 10-06-257

DUE DATE

7-11-70

COMPANY: OBRIENT & GERE ENGINEERS INC. ADDRESS: IOU SUMMER ST. BUSION!									iamplictype		CONTAINER TYPE													
PHONE P.O. # CLIENT PROJE	3 4 5	I. WATER 2. SOIL 3. SLUDGE 3. OIL 5. TISSUE DTHER	(P-PLAS G-GLAS /-VOA	s /92	THE TOP	A PARTY		100 V								7							
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Tenandol, Tomeri TIME: -2:-30 RECEIVED BY: TIME: -2:-30								DATE: 6-27-90 TIME: 14-20-CM					SI	SPECIAL INSTRUCTIONS:										
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225 Wildwood Ave., Woburn, MA 01801 Telephone: (617) 933-6903 Fax: (617) 933-9196

CHAIN OF CUSTODY RECORD

WORK ORDER #: 10-06-25-1

DUE DATE

7-11-90

COMPANY: O BRIFN & GFRE ADDRESS: 100 SUMMEN & 1. 130 YTO N PHONE #: (617) 423 - 2919 FAX #: () 473 -0626 P.O. #: CLIENT CONTACT: ED ZIMMEN MANN PROJECT ID/LOCATION: NAVIAL GRUJUN, CUM									SAMPLETYPE CONTAINER				NERTYP	PE ANALYSES											
									1. WATER 2. SOIL 3. SLUDGE 4. OIL 5. TISSUE OTHER			P · PLASTIC G · GLASS V · VOA) }/					//					
TOXIKON	SAMPLE IDENTIFICATION	SAN TY	IPLE PE	CO	NTAH		SAMI DATE	PLING	PRES	ERVATIVE	$\overline{}$		\d							//				COMMENTS	
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LABORATORY ANALYSis REPORT

TH TRAVELERS INSURANCE COMPANIES Engineering Division Hartford, Connecticut

ANALYIS NO.: 900022 (6-24)1862.022

SURVEY DATE: 1/8/90

CUSTOMER

O'Brien & Gere Engineers, Inc.

SAMPLE SENT BY

1/11/90

Boston, Mass. DATE RECIEVED DATE REPORTED

1/18/90

ADDRESS

ANALYST

TIG/MMC.

Edward Zimmerman MATERIAL ANALYZED

Charcoal Tubes

SAMPLE NUMBER LOCATION

(and/or employee)

TEST RESULTS

Submarine Base New London, Groton, CT - File 1862.023

S1 and 52

Up wind of gas station-Mark A. Randazzo

Benzene LT 0.002 ppm

Toluene 0.004 ppm

Ethyl benzene LT 0.002 ppm

Xylenes 0.002 ppm

RECEIVED

JAN ? 6 1009

O'ERIEN & GERE ENGINEERS, INC. BOSTON, MA

Special Notes:

Report faxed to Mr. Zimmerman, 1/19/90 PM

Engineering Laboratory LABORATORY ANALYSI REPORT Extension Sheet THE TRAVELERS INSURANCE COMPANIES Extra Division Hartford, Connecticut

ANALYIS NO.: 900022 (6-24)

SURVEY DATE: 1/8/90

CUSTOMER

ADDRESS

O'Brien & Gere Engineers, Inc.

Boston, Mass.

SAMPLE NUMBER LOCATION (and/or employee)

TEST RESULTS

Submarine Base New London, Groton, CT - File 1862.023

S3 and

Cashiers booth on Island #2-Mark Randazzo

Benzene 0.006 ppm

Toluene 0.011 ppm

Ethyl benzene 0.001 ppm

Xylenes 0.003 ppm

Special Notes:

Engineering Laboratory LABORATORY ANALYSI REPORT Extension Sheet

TIT TRAVELERS INSURANCE COMPANIES Engineering Division Hartford, Connecticut

ANALYIS NO.: 900022 (6-24)

SURVEY DATE: 1/8/90

CUSTOMER

ADDRESS

O'Brien & Gere Engineers, Inc.

Boston, Mass.

SAMPLE NUMBER

LOCATION (and/or employee)

TEST RESULTS

Submarine Base New London, Groton, CT - File 1862.023

S5 56 Down wind of site-Mark A. Randazzo

Benzene NDLT 0.002 ppm

Toluene LT 0.002 ppm

Ethyl benzene NDLT 0.001 ppm

Xylenes LT 0.001 ppm

Special Notes:

Engineering Laboratoy LABORATORY ANALYSIS REPORT Extension Sheet

THE TRAVELERS INSURANCE COMPANIES Engineering Division Hari ord, Connecticut

ANALYIS NO.: 900022 (6-24)

ANALYTICAL METHODS

CUSTOMER

ADDRESS

O'Brien & Gere Engineers, Inc.

Boston, Mass.

Atomic Absorption - Furnace (AA-HGA)

Ion Chromatography (IC)

Atomic Absorption - Flame (AA-F)

Infrared Spectroscopy (IR)

Atomic Absorption - Hydride (AA-HYD)

Liquid Chromatography (LC)

Carbon Black - GRV/MIC1

Mass Spectrometry (MS)

Carbon Black - OSHA VI-15

Microscopy (MIC)

Colorimetry

Phase Contrast Microscopy (PCM)

Extraction

Polarized Light Microscopy/

Explosivity

Dispersion Staining (PLM/DS)

Flammability

Special

Potentiometry

Flash Point - Closed Cup

X Gas Chromatography

Titrimetry

Gravimetry (GRV)

Transmission Electron Microscopy (TEM)

Inductively Coupled Argon Plasma Emission Spectroscopy (ICP)

X-Ray Diffractometry (XRD)

Other

_Analytical methods used to determine concentrations of requested substances are based on reference methods from NIOSH/OSHA/EPA/published literature or are specially developed at The Travelers Engineering Laboratory and are optimized to suit our sampling and analytical instruments and techniques.

¹Carbon black concentrations reported are estimated by microscopic examination of data.

Result(s) reported for respirable particulate exclude respirable silica fraction, which is reported separately.

NIOSH 7400 method does not distinguish between the asbestos and other fiber types present. This method requires that all fibers meeting the set criteria be counted. Transmission Electron Microscopy is recommended to identify the type(s) of fiber(s) Tand to determine the quantity present.

Engineering Laboratory
LABORATORY ANALYSIS PEPORT
Extension Sheet

THE TRAVELERS INSURANCE COMPANIES Enginering Division Hart.ord, Connecticut

EXPLANATION OF TERMS

The raw analytical data will be stored by The Engineering Laboratory for 3 years.

The reported data relate only to the samples as received by The Travelers Engineering Laboratory.

LDD - Limit of Detection

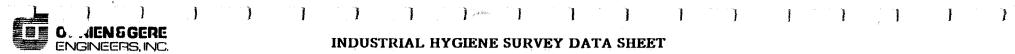
LT - "Less Than" concentration is the amount observed below the normally acceptable LOD and which lacks confidence if quantitated at actual levels present. It is calculated based on the LOD.

NDLT - "None Detected, reported as Less Than concentration" is the limit of sensitivity based on the sampling and analytical methodology. It is the concentration calculated based on the LOD, when none was observed under the conditions of analysis.

GT - "Greater Than" is the concentration reported, due to overloading and/or breakthrough of substance of interest. It may also be due to damaged sample.

Analyses were performed under provisions in the Travelers contract signed by you or a representative of your company.

11/89



INDUSTRIAL HYGIENE SURVEY DATA SHEET

CLIENT: NOWFACE WARCOM LOCATION: CHARACTE CT CLIENT NO. 1862 . 623. SURVEY DATE: 12/14/89

	SAMPLING PUMP DATA								
ump Type: بر	رز جرصد ج		Manufacturer: Callian	Model: HES 113A					
Serial Number	OBG Number		REASON FOR SAMPLING - INCLUDE PROCESS OR OPER/	ATION DESCRIPTION & CONTROLS					
21939	ده ٠	1.009 9 LVOC	-) Backy round, Auch , and (million)	(mg (125)					
219 43	Α2	0-9954 (40	cay owinter (maker conting (120)						
21929	A 3_	1.007 1/m (VOCs) Down with all of the luner coming	1.05)					

Collection (sampling) Media: Analysis Required:

					SAMPLE DATA	4					
OBG Instr.	Sample	Sampling Location	Collect	ion Time	Collection Duration		Sampler		Exposure	Shift Duration	COMMENTS
No.	No.	(include employee's name)	Start	End	(in mins.)	ľ	Position			(mins.)	33
A 5	5-1	Constant Her K Hexican	1:65	3:455	410	Liev¶ Ly	E.,	3	430	120	دامهد و بله بلدد و سهد دروزد در سرا برا وده و فران سخ ک کند دروزد ده سرامه در سام درسوه می دروزد
A 4	5-2	در در الاسر الادراس	11:05	3.45 8m	410	1.00CM Lym	E v-J	3	420	420	Fur Kust from the point
A2	S-3	At and Appenium to Berylo or Trainer to a continue Buylor Court Have Berly	1:46	Wies Am	114	0.9915 Yu	رسيح	λ,	430	436	closest tome pour
A2	5-4	ر، من برواد مد که رائم	Tul	W1.00 2.000	114	0:9975 Ym	Ewa.	3	صوبي	et See	Forkust from the good
84	3.5 Spering Core	De summer of Site.	1:07 4-4-	1	464	1.007 1/m	Env	3	et Zib	42p	closect to K. , pume
84	9-6	Casellan Beiley	9:07	4:51 Town	464	1.007 Ym	2-4	3	مرى	رو يحت	Forkest Snow was bromb.
Manager:			Hygieni	st:					Sampler:		

INDUSTRIAL HYGILM URVEY DATA SHEET

NA A STATE A STATE OF THE STATE	Sub Base-New Condon	104	, ,) G.
CLIENT: NAUFAC-Eng. COM-	LOCATION: Groton CT	CLIENT NO. 1862 . 623.	SURVEY DATE:	70

	SAMPLING PUMP DATA										
Pump Type:	+; F1	Sampler Hanufacturer: Gilian	Model: HFS 113A								
Serial Number	OBG Number	REASON FOR SAMPLING - INCLUDE PROCESS OR OPERATI	ON DESCRIPTION & CONTROLS								
21939	٧١	1,009 m/min (VOC'S) Background									
21929	42	4007 mlmy (NOC'S) On-site									
21943	Δ3	9975ml/min (VOC'S) Down Wind									
			ı								

Collection (sampling) Media: Analysis Required:

	SAMPLE DATA										
OBG			Collection Duration	Flow	Sampler	No. of Persons	Exposure	Shift Duration	COMMENTS		
No.	No.	(include employee's name)	Start	End	(in mins.)	Rate	Position			(mins.)	5572015
Al .	s-1	Up Wind of Gas Station Mark A. Randazzo	6932	16130	4/8	1	A Tube oxiside	3	420	420	Furthest From Aump P#21939
۸۱	5-2	Same	09;32	16:30	4/8	1	stube	خ	420	420	Closest to Pump
42	5-3	Cashiers Booth on Island & ? Mork A. Randuzzo	09:29	7:21	480	11 -	ATAbe ovtsde	3	420	426	Furtherst From Aump
A2	5-4	·	09:29	87,29	480		0 Tube outside	3	420	420	closest to Pump
ΑJ	5-5	Down wind of site Mark A. Randazzo	09:25	/4:00	275	l n	ATUSE Outside	3	420	420	Furthest from the Pump
23	5-6	Same	09:25	14:00	275	2	e tube outside Env.	3	420	42 9	Close to the Pump
Manager: '	Tom	A. Jordan	Hygienia	ie: M	ork M	126	ovan		Sampler:	Mark	11 A. Randazezo

Emm (41000	'66" .RS.	E
EIV	(SIN 1	.AS,	NC.

		LOCATIO			LING PUMP	DATA						
p Type:			Nanufactu	ırer:							Model:	-
Serial Number	OBG Numbe	•	REASON	FOR SAMP	LING - INC	LUDE PR	OCESS OR	OPERATIO	N DESCRIP	TION & CO	NTROLS	
	-			-	····	-	· .		· 			
·							* **		Į.			

ection (sampling)	Media:	Analysis	Required):						· · · · · · · · · · · · · · · · · · ·	
ection (sampling)	Medie:	Analysis	Required	:							
ection (sampling)			ion Time	SAMPLE DATA			No. of	Exposure	Shift		
	Sample No.	Sampling Location (include employee's name)		ion Time	SAMPLE DATA	flow		Persons		Shift Duration (mins.)	COMMENTS	
ig itr.	Sample	sampling Location (Include amployee's name) Field Blank Mark Randa320	Collect	ion Time	SAMPLE DATA Collection Duration	flow	Sampler	Persons	Time	Duration	COMMENTS	
ig itr.	Sample No.	sampling Location (include amployee's name) Field Blank	Collect Start	ion Time	SAMPLE DATA Collection Duration	flow	Sampler	Persons	Time	Duration	COMMENTS	
G tr.	Sample No.	sampling Location (Include amployee's name) Field Blank Mark Randa320	Collect Start	ion Time	SAMPLE DATA Collection Duration	flow	Sampler	Persons	Time	Duration	COMMENTS	
G tr.	Sample No.	sampling Location (Include amployee's name) Field Blank Mark Randa320	Collect Start	ion Time	SAMPLE DATA Collection Duration	flow	Sampler	Persons	Time	Duration	COMMENTS	
ig str.	Sample No.	sampling Location (Include amployee's name) Field Blank Mark Randa320	Collect Start	ion Time	SAMPLE DATA Collection Duration	flow	Sampler	Persons	Time	Duration (Mins.)	COMMENTS	

JAN-19-89 THU (6:18 VALLEY VIEW

P. 93

P,02

1066106

5032

file

Tom Remond

Dita

alley iew

Enterprises, Inc.
Constructors & Consultants

January 19, 1989

OICC - Department of the Navy Box 26 - Building 135 U.S. Naval Submarine Base New London/Groton, CT 06340

Attn: Lt. Frankel

RE: Replace Fuel Oil Tanks
U.S. Naval Submarine Base
New London/Groton, CT
Contract N62472-88-C-3528

Dear Sir:

In reference to the above captioned project, please find enclosed Eastern Scientific Laboratories' test results for soil and water samples which were taken from Building 428, after the removal of the existing tanks.

Please be advised that Valley View Enterprises, Inc. is proceeding with the re-installation of the Two (2) Ten Thousand (10,000) gallon replacement Tanks, unless directed otherwise.

Should you have any questions and/or comments, please contact the writer at (203) 564-2724.

Very truly yours,

VALLEY VIEW ENTERPRISES, INC.

Richard J. Karter

Assistant Operations Manager

/dlp

CT-O/GC

HALDOENATED VOLATILE ORGANICS

EASTERN SCIENTIFIC LABORATORIES (PH 0465) P.O. BOX 700

BROOKLYN, CT Ø6234

MEFORT TU:

BOURCE OF SAMPLE: JOB 4044

FUEL TANK REMLACEMENT

METHOD BOID

SWA 846 3RD EDITION

125

17.0

125

175

500

1,000

ATTINE LOW GOLDEN

VALLEY VIEW ENTERPRISES

1,1.1,7-TETRACHLOROFTHANE

TETRACHLUROCTHYLENE ----

1,1,1-TRICHLORDETHANE ------

1,1.0 TRICH, CROETHARK CONTRACTOR OF THE PROPERTY OF THE PROPE

TRICHLORDETHYLEND ------

TRICH UNOFILIOROMETHANE -----

TRICHLOROPROFAME

VINYL CHUGGIDE

SHEMITTED SOIL SAMPLE #: VV-9902

212 NEW ROAD 封(月)5(1)21 07 063514

DATE/TIME COLLECTED:

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	PARAMETER	RESULTS (US/KB)		LIMITS (UG/KG)
	· · · · · · · · · · · · · · · · · · ·	Carried and the same should be sufficient to the same state of the		
property.	DEMOYE CHEORODE		man age or grant age of the same same undirection.	1,60.0
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	TRONDETHAND	NI)	and the second second second second	1.4件后药
	CORROW TETRACHIORIDE	ND ND	grap, men mena sada per agai 813 p. s.	175
	CHLOROACETAL DEHYDE	ND	management of the second second	1,000
	CH Marie Harring	ND	ويتدايم ومنصف فيوست الراغم بيت	្រូវមាល
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· 我我我们们就是我们的我们的是我们的,那是我们的人,我们就是我们的人,我们就是我的人,我们们也不是什么不是,这个人,不是是什么。

ROBERT LAFFRRICHE, CHIEF CHEMIST

T.F. MCCOMMAG, BIRECTOR

INT 4 2 CHES 4 4 ACTOC

EASTERN SCIENTIFIC LABORATORIES (PH 0465) P.O. BOX 700

BROOKLYN, CT Ø6234

REPORT TO:

VALLEY VIEW ENTERPRISES

WILL FOR GOLDEN

212 NEW ROAD

MODSUF, CT 26354

SOURCE OF SAMPLE: JOB #044

FUEL TANK FEPLACEMENT

SUBMITTED WATER

SAMPLE #: VV-8901

DATENTIME COLLECTED: 1/12/69

HALOGENATED VOLATILE GRGANI		ME	THOD 8010
			46 3RD EDITION
	RESULTS (UG/L)		ION LIMITS (UG/L
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, 2-D1CHLOROPROPANE	ND	demanda area de la que en después de la caración de	0.20
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REPORT IS AN ACCURATE AMADYS, OF SABELE RECEIVED IN THIS LABORATORY.

1/16/85

T.F. HOCOMMAS, DINECTOR DATE ROBERT LAFERRIERE, CHIEF CHEMIST

Boleet Laseum.

EASTERN SCIENTIFIC LABORATORIES (PH Ø465) P.D. BOX 700 BROOKLYN, CT 06234 (203) 774-6814

REPORT TO:

VOLLEY VIEW ENTERPRISES

ATTN: LOU GOLDEN

212 NEW BOAD

MUUSLE, OT 06354

SUURCE OF SAMPLE: JOB #044

FUEL TANK REPLAUMENT

SURMITTED WATER

SAMPLE #: VV-8901

DATE/TINE COLLECTED: 1/12/89

AROMATIC VOLATILE ORGANICS

METHOD 9020

SWA 846 3RD EDITION

PARAMETER

RESULTS (UG/L)

DETECTION LIMITS (UG/L)

	MTRE	10,151	graph game take sardy space were salely miles death dense	10
~	CHI OROBENZENE	ND		0.00
	TOTAL DICHLOROBENZENE	ND		<i>0.50</i>
•	TOTAL XYLENES	9,494	and the same and that the same that the same	0.50
	ETHYL-BENZENE	1,057		0.50
ntes.	TOLUENE	5,698	क्षां प्रकार त्राप्त काला काला सामा पेकत काला सुवित विवत	0.50
	BENZENE	2,841	and the wife table of a special state and disk	0.50
		•		

ND=NONE DETECTED

REPORT IS AN AUGURATE ANALYSIS OF SAMPLE RECLIVED IN THIS LABORATORY.

T.F. NCCOMMAN, DIRECTOR

ROBERT LAFERRIERE, CHIEF CHEMIST

FM/OM20LI

. 263) 774 6814 °

CT LOBORATORY FH 0465

FASTERN SCIENTIFIC ASSUCIATES DIV. OF LABORATORY RESOURCES, INC. P.O. BOX 788 BROOKLYN, OT 06234

REPORT TO:

SOURCE OF SAMPLEY JOB #044

FLIEL TAME REPLACEMENT

VALLEY VIEW ENTERPHISES ATTH: LOU GOLDEN 212 MLW ROAD MODBUP, CT 06554

CAMPLE 4: AS NOTED

TYPE OF SUPPLY: AS NOTED

DATE/TIME COLLECTED: 1/12/09

ANALYSIS

RESULTS

DETECTION

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LIMITS

ANALYSIS

SAMPLE # VVEGOT

LOCATION: WOTER

TOTAL PETROLOGM --- \$9,240 UM/I HYDROCARDONS AS GASOLINE FUEL

---- 50 UG/L AS GASOLINE FUEL

SAMPLE # VV8902

LOCATION: SOIL

Consti 6. L. C

TOTAL PETROPOLIM --- 357 MG/KG

------ 10 MG/KG HYDROCARBONS AS GASOLINE FUEL AS GASOLINE FUEL

ND=NONE DETECTED

THIS IS A CERTIFIED SAMPLE JAKEN BY LAB. PERSONNEL. IF NOTED BELOW

VERIFIED BY:

T.F. HOCOMMOS.

OF

WILL

FMZ自10kk

ROBERT LAFERRIERE, CHIEF CRUSSIA

REPORT IS AN ACCURATE ANALYSIS OF

SAMPLE RECEIVED IN THIS LABORATORY

EASTERN SCIENTIFIC LABORATORIES (PH .0465) P.O. BOX 700 BROOKLYN, CT Ø6234 (203) 774-6814

REPORT TO:

VALLEY VIEW ENTERPRISES ATTN: LOU BOLDEN 212 NEW ROAD MCCHARL CT 06354

SOURCE OF SAMPLE: DOB #044

PUBL TANK REPLACEMENT

SUBMITTED SOLL

SAMPLE #: VV-9902

DATE/TIME COLLECTED: 1/12/89

AROMATIC VOLATILE DRGANICS

METHOD 8020

SWA 846 3RD EDITION

PARAMETER

RESULTS (UG/KG)

DETECTION LIMITS (UG/KG) 是我们的现在分词,就是被你我们不是我们是我们的一个一个点点,你们就是你的一个一个点点,但我们就是我们的一个一个点点,你们就是我们的一个一个一个一个一个一个一个一个

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Markin	TOLUENE	1,886	and a state state state state state from bottom	500
	ETHYL-BENZENC	820	atout 4.50. Otto date with days diff? \$170.1001. date	500
	TOTAL XYLENES	7,237	norm major with displayed blade short Males Major (PA)	500
	10TAL DICHLORDBENZENE	ND	alian taga anali ana kina kina pina dara an Ma	200
SEASON .	CHLOROBENZENE.	ND	and the state of t	500

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T.F. MCCOMMAS, BIRECTOR

ROBERT LAFERRIERE; CHIEF CHEMIST

FMZBBBBBB

APPENDIX H QUALITATIVE RISK EVALUATION INFORMATION

TABLE 1
AIR SAMPLING RESULTS

Chemical	Upwind S1 & S2	On-Site S3 & S4	Downwind S5 & S6
Benzene	<0.002	C.006	<0.002
Ethylbenzene	0.004	0.001	<0.002
Toluene	<0.002	0.011	<0.001
Xylene	0.002	0.003	<0.001

Notes: Samples collected in January 1990

Analyses by gas chromatography

TABLE 2

MONITORING WELL SAMPLING RESULTS

	08G-1 12/89	08G-2 12/89	0BG-3 12/89	0BG-4 12/89	08G-5 12/89	08G-6 12/89	08G-7 6/89 6/90	0BG-8 .6/89 .6/90	08G-9 6189 6/90	Maximum Conc.
Chemical (ppb)										
Benzene	43995	32080	<0.5	21	<0.5	1210	<.5	<.5	1000	43995
Bromobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	5	<.5	<.5	5
Butylbenzenes (total)	<0.5	5950	<0.5	<0.5	<0.5	<0.5	<.5	<.5	1200	5950
2-Chlorotoluene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<.5	<.5	140	140
1,3-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<.5	<.5	1600	1600
Ethylbenzene	22420	110100	<0.5	<0.5	<0.5	400	<.5	<.5	1300	110100
Hexachlorobutadiene	<0.5	2680	<0.5	<0.5	<0.5	<0.5	<.5	<.5	<.5	2680
Naptha l ene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<.5	<.5	400	400
N-Propylbenzene	6250	2610	<0.5	<0.5	<0.5	<0.5	<.5	<.5	<.5	6250
Toluene	100570	33580	<0.5	6	<0.5	250	3	<.5	4000	100570
Trimethylbenzenes (total)	4240	21720	<0.5	<0.5	<0.5	<0.5	<.5	<.5	650	21720
Xylenes (total)	52260	25200	<0.5	1.7	<0.5	680	<.5	<.5	3800	52260
TPH (ppm)	5090	625	<1	<1	<1	288	<1.0	<1.0	<1.0	5090
Fuel Oil Fingerprint	gasoline	gasoline	NA	NA	NA	NA	NA	NA	NA	-

TMB = Trimethylbenzene

TPH = Total petroleum hydrocarbons

Notes: * Fuel Oil Fingerprint tests were performed on free-phased floating product, if any.

^{*} Samples analyzed by EPA Method 503

TABLE 3
SOIL SAMPLING RESULTS

0 - 3		0 - 3						
3 - 5	9 - 11	3.5-5.5	7 - 9	7 - 9	7 - 9	6.5-8.5	4 - 6	Maximum Conc.
3 .	32270	<2.0	310	280	<2.0	<2.0	1500	32270
<2.0	39705	<2.0	40	60	<2.0	<2.0	500	39705
7	71235	<2.0	200	13191	<2.0	<2.0	1500	71235
35	147100	<2.0	950	810	<2.0	<2.0	2500	147100
163	2240	52.2	11400	3900	526	106	<40	11400
(7 - 9)		(5.5-7.5)		(9 - 11)		***************************************	(4 - 6)	
gasol ine	NA	none	NA	K, D			gasoline	
	3 <2.0 7 35	3 - 5 9 - 11 3 32270 <2.0 39705 7 71235 35 147100 163 2240	3 32270 <2.0 <2.0 39705 <2.0 7 71235 <2.0 35 147100 <2.0 163 2240 52.2 (7 - 9) (5.5-7.5)	3 32270 <2.0 310 <2.0 39705 <2.0 40 7 71235 <2.0 200 35 147100 <2.0 950 163 2240 52.2 11400 (7 - 9) (5.5-7.5)	3 32270 <2.0 310 280 <2.0 39705 <2.0 40 60 7 71235 <2.0 200 13191 35 147100 <2.0 950 810 163 2240 52.2 11400 3900 (7 - 9) (5.5-7.5) (9 - 11)	3 - 5 9 - 11 3.5-5.5 7 - 9 7 - 9 7 - 9 3 32270 <2.0	3 - 5 9 - 11 3.5-5.5 7 - 9 7 - 9 7 - 9 6.5-8.5 3 32270 <2.0	3 - 5 9 - 11 3.5-5.5 7 - 9 7 - 9 7 - 9 6.5-8.5 4 - 6 3 32270 <2.0

D = diesel oil

Notes:

- * OBG-1 to OBG-6 were collected in December 1989; OBG-7 to OBG-9 were collected in June 1990
- * The samples were collected from the interval with the highest organic vapor concentration (determined with a photoionizer)
- * OBG-3 was not sampled since the photoionizer did not detect organic vapors in this boring.
- * Fuel oil fingerprints were performed on oil-saturated soil, if any

K = kerosene

NA = not analyzed

TPH= total petroleum hydrocarbons

TABLE 4 CATCHBASIN SAMPLING RESULTS

	CB-	1A	CB-	1B *****	CB	-4 *****	CB	-5 *****	CB	*****	Outfall-1	Maximum
	11/89	12/89	11/89	12/89	11/89	12/89	11/89	12/89	11/89	12/89	1/8/90	Conc.
Chemical (ppb)											!	
Benzene	17	40	4850	800	20	107	52	95	<0.5	<0.5	<0.5	4850
Butylbenzenes (total)	<0.5	<0.5	830	72	<0.5	<0.5	17	<0.5	<0.5	<0.5	<0.5	830
Ethylbenzene	<0.5	1	<0.5	308	<0.5	2	<0.5	4	<0.5	<0.5	<0.5	308
Toluene	18	41	3680	661	<0.5	99	16	99	<0.5	<0.5	<0.5	3680
1,3,5-TMB	<0.5	<0.5	351	58	<0.5	7	8	8	<0.5	<0.5	<0.5	351
Xylenes (total)	2	6	850	185	3	18	18	19	<0.5	<0.5	<0.5	850
TPH (ppm)	<1.0	19.2	3.2	21.8	<1.0	4.9	<1.0	<1	<1.0	8	<1.0	21.8
Fuel Oil Fingerprint	NA		NA		G,K,D		NA		NA		NA	
Sheen	none		slight	:	slight	:	slight		none			
0dor	none		strong	ı	none		none		none			

⁼ gasoline

Notes: * CB-2, CB-3, and CB-6 were not sampled in 11/89 or 12/89

^{*} kerosene

⁼ diesel fuel

TMB = Trimethylbenzene

TPH = Total petroleum hydrocarbons

^{*} FOFP test on CB-4 was conducted in January 1990

^{*} Both sampling dates represent dry weather conditions

^{*} Samples analyzed for volatile organics by EPA Method 503, TPH by IR

TABLE 5
SUMMARY OF CHEMICALS DETECTED IN ENVIRONMENTAL MEDIA

Air	Ground Water	Soil	Catch Basin
(ppm)	(ppb)	(ppb)	(ppb)
0.006	43995	32270	4850
NA	5	NA	<0.5
NA	5950	NA	830
NA	140	NA	<0.5
NA	1600	<2.0	<0.5
0.001	110100	39705	308
NA	2680	NA	<0.5
NA	400	NA	<0.5
NA	6250	NA	<0.5
0.011	100570	71235	3680
NA	21720	AK	351
0.003	52260	147100	850
NA	5090	11400	21.8
	0.006 NA NA NA O.001 NA NA O.011 NA	(ppm) (ppb) 0.006 43995 NA 5950 NA 140 NA 1600 0.001 110100 NA 2680 NA 400 NA 6250 0.011 100570 NA 21720 0.003 52260	(ppm) (ppb) (ppb) 0.006 43995 32270 NA 5 NA NA 5950 NA NA 140 NA NA 1600 <2.0 0.001 110100 39705 NA 2680 NA NA 400 NA NA 6250 NA O.011 100570 71235 NA 21720 NA 0.003 52260 147100

NA = not analyzed

TMB = Trimethylbenzene

TPH = Total petroleum hydrocarbons

Note: The maximum concentrations detected in each matrix are shown.

TABLE 6

CHEMICAL RELEASE SOURCES

latilization	Wastes
ırface runoff	Wastes
Leaching	Contaminated soil
Leaching	Wastes
	-

^{*} catchbasin system

TABLE 7

SUMMARY OF PHYSICAL AND ENVIRONMENTAL FATE DATA
FOR CHEMICALS OF POTENTIAL CONCERN

	Koc (ml/g)	Log Kow	Water Solubil- ity (mg/l)	Henry's Law Constant (atm*m3/mol)	Vapor Pressure (mm Hg)	Fish BCF (l/kg)	Half-life (days) in surface water	Source
Benzene	83	2.12	1750	5.59E-03	9.52E+01	5.2	1.00 - 6.00	EPA
Bromobenzene		3.07	360		1.00E+01			HSDB
Butylbenzenes					5.70E+00			HSDB
2-Chlorotoluene	370	3.42	89	6.70E-03	3.60E+00	234	12	HSDB
1,3-Dichlorobenzene	1700	3.60	123	3.59E-03	2.28E+00	56		EPA
Ethylbenzene	1100	3.15	152	6.43E-03	7.00E+00	37.5	1.50 - 7.50	EPA
Hexachlorobutadiene	29000	4.78	0.15	4.57E+00	2.00E+00	2.8	29.00 - 2300.00	EPA
Napthalene	933	3.29	31.7	4.60E-04	8.70E-02			EPA
N-propylbenzene			60					HSDB
Toluene	300	2.73	535	6.37E-03	2.81E+01	10.7	0.17	EPA
Trimethylbenzenes					1.86E+00		•	HSDB
Xylenes	240	3.26	198	7.04E-03	1.00E+00		1.50 - 9.00	EPA

NA = not available PERS = persistent

Sources: EPA = "Superfund Public Health Evaluation Manual". United States Environmental Protection Agency. Office of Emergency and Remedial Response. EPA/540/1-86/060. October 1986. HSDB = Hazardous Substances Database. August 1990.

TABLE 8

POTENTIAL MIGRATION PATHWAYS
AND EXPOSURE POINTS

Release Source	Release Mechanism	Transport Medium	Exposure Point
wastes	volatilization	air	on-site air
wastes	volatilization	air	off-site air
contaminated GW	GW seepage	SW	catchbasin system
contaminated SW	surface runoff	SW	Thames River
contaminated soil	surface runoff	SW	catchbasin system
wastes	leaching	GW	on-site wells
wastes	leaching	GW	off-site wells
Wastes	leaching	soil	on-site

TABLE 9

- POTENTIAL EXPOSURE ROUTES AND EXPOSURE PATHWAYS

Exposure Point	Complete/ Incomplete	Future Complete/ Incomplete	
on-site	complete	complete	
off-site	incomplete	incomplete	
catchbasin system	incomplete	incomplete	
Thames River	incomplete	incomplete	
on-site wells	incomplete	incomplete	
off-site wells	incomplete	incomplete	
on-site	incomplete	incomplete	
off-site	incomplete	incomplete	
	on-site off-site catchbasin system Thames River on-site wells off-site wells	on-site complete off-site incomplete catchbasin system incomplete Thames River incomplete on-site wells incomplete off-site wells incomplete	

Ing = ingestion, Inh = inhalation, Derm = dermal contact

FROM: ENS BAUMIS

DATE: 18 OCT 1989

Subj: CONTRACT N62472-88-C-3528 REPLACE FUEL OIL STORAGE TANKS, NAVAL

SUBMARINE BASE NEW LONDON, GROTON, CT

1. On 10 October 1989 gasoline was discovered in storm sewers adjacent to the Naval Exchange Gas Station, building 428. Under subject contract Valley View Enterprises, Inc replaced two steel underground gasoline storage tanks and piping from the tanks to the three islands closest to building. The piping between the third and fourth, and between the fourth and fifth islands was not excavated or affected under subject contract.

- 2. The steel tank closest to the building is filled with Unleaded Supreme. Gasoline. The other steel tank is filled with Unleaded Plus Gasoline. The fiberglass tank which was existing at the time of this contract, is filled with Regular Unleaded Gasoline. The island closest to the building serves Regular Unleaded Gasoline. All piping from a previously existing tee in the vicinity of the fiberglass tank to the crash valve at the bottom of the pumps was replaced under subject contract. The second island from the building serves Unleaded Plus gasoline. All piping from the tank up to and including the crash valves was replaced under subject contract. The third island serves unleaded Supreme Gasoline. All piping from the tank to the crash valve at the dispenser was put in under subject contract. The fourth and fifth islands serve Regular Unleaded Gasoline. All piping for these dispensers was existing and not affected by subject contract. The second island (the Plus island) is the only island where the crash valves were installed by Valley View (one was broken by Valley View during demolition, the other was missing.)
- 3. To find where the gas in the sewer system was originating an emergency informal contract was awarded to Pasquallini to test the tanks and piping. In the morning of 11 October 1989 when C.P. Utilities, Pasquallini's subcontractor, began hydrostatic testing of the tank and piping systems, they discovered a significant leak in the crash valve in the south dispenser pump on the second island from building 428. When the crash valve was closed, gas was leaking out at approximately 2-4 ounces per minute. Ensign Baumis called Rick Carter of Valley View to replace the crash valve under warranty. By 6:30pm, 11 October 1989 the valve was replaced by Nutmeg Mechanical, Valley View's subcontractor.
- 4. This removed crash valve was one installed by Valley View Enterprises under the contract because the existing crash valve was broken during demolition. The day before the gas station reopened, approximately 21 February 1989, Meter and Tank, the contractor who services the gas station, was called to calibrate the pumps. During calibration Meter and Tank discovered that the crash valve at the south pump on the second island was not operating correctly. It was not allowing gas to flow through the valve while it was in the open position. Nutmeg, Valley View's subcontractor replaced the valve on 21 or 22 February 1989. It seemed to operate correctly; it allowed gas to be pumped through the dispenser and closed when it was actuated to do so. When the dispenser cover was replaced, no leak was noticed.

- 4. Everett from Nutmeg Mechanical kept the crash valve he removed on 11 October 1989 because he noticed a crack in the housing of the valve. The crack was in the upper half of the valve housing, above the diaphram that is to stop gas flow to the dispenser in the event the dispenser is knocked over.
- 5. The testing performed by C.P. Utilities on 11 and 12 October 1989 shows that neither the newly installed steel tanks, nor the existing fiberglass tank are leaking. The Regular Unleaded piping, part of which was new, is not leaking. The piping for the Unleaded Plus Gasoline, all new piping, is also not leaking.
- 6. The Unleaded Supreme piping did not pass the test on 11 October 1989. A section of Supreme piping was extended, at time of installation, to the first island in case a switchover to Supreme was ever desired. This capped vertical pipe appeared to be leaking slightly; the top of the pipe was wet with gasoline. On 13 October 1989 Valley View was called, and the cap was replaced by Valley View with a bleeder valve. The bleeder allows air in the system to be released since air in the system would produce erroneous results. C. P. Utilities retested the Supreme piping the afternoon of 13 October 1989 and found no leaks.
- 7. On 16 October 1989 the Office of Counsel was sent a draft of a letter informing Valley View of the facts of the gas leak situation. The advice from Dave Petrone was to not send any letter to the contractor until the Government decided on whether or not to pursue liability. He was in contact with the Subase JAG and NDIV Environmental. He said a decision regarding liability would be made within the next few days.

Benzene

BENZENE

Summary

Benzene is an important industrial solvent and chemical intermediate. It is rather volatile, and atmospheric photooxidation is probably an important fate process. Benzene is a known human carcinogen, causing leukemia in exposed individuals. It also adversely affects the hematopoietic system. Benzene has been shown to be fetotoxic and to cause embryolethality in experimental animals. Exposure to high concentrations of benzene in the air causes central nervous system depression and cardiovascular effects, and dermal exposure may cause dermatitis. The EPA Ambient Water Quality Criterion for the protection of human health corresponding to an excess cancer risk of 10 $^{\circ}$ is 0.66 $\mu g/liter$.

CAS Number: 71-43-2

IUPAC Name: Benzene

Chemical Formula: C6H6

Chemical and Physical Properties

Molecular Weight: 78.12

Boiling Point: 80.1°C

Melting Point: 5.56°C

Specific Gravity: 0.879 at 20°C

Solubility in Water: 1,780 mg/liter at 25°C

Solubility in Organics: Miscible with ethanol, ether, acetic

acid, acetone, chloroform, carbon disulfide, and carbon tetrachloride

Log Octanol/Water Partition Coefficient: 1.95-2.13

Vapor Pressure: 75 mm Hg at 20°C

Vapor Density: 2.77

Flash Point: -11.1°C

Benzene Page 1 October 1985

Transport and Fate

Volatilization appears to be the major transport process of benzene from surface waters to the ambient air, and atmospheric transport of benzene readily occurs. Although direct oxidation of benzene in environmental waters is unlikely, cloud chamber data indicate that it may be photooxidized rapidly in the atmosphere. Inasmuch as volatilization is likely to be the main transport process accounting for the removal of benzene from water, the atmospheric destruction of benzene is probably the most likely fate process. Values for benzene's log octanol/water partition coefficient indicate that adsorption onto organic material may be significant under conditions of constant exposure. Sorption processes are likely removal mechanisms in both surface water and groundwater. Although the bioaccumulation potential for benzene appears to be low, gradual biodegradation by a variety of microorganisms probably occurs. The rate of benzene biodegradation may be enhanced by the presence of other hydrocarbons.

Health Effects

Benzene is a recognized human carcinogen. Several epidemiologic studies provide sufficient evidence of a causal relationship between benzene exposure and leukemia in humans. Benzene is also a known inducer of aplastic anemia in humans, with a latent period of up to ten years. It also produces leukopenia and thrombocytopenia, which may progress to pancytopenia. Similar adverse effects on the blood cell producing system occur in animals exposed to benzene. In both humans and animals, benzene exposure is associated with chromosomal damage, although it is not mutagenic in microorganisms. Benzene was fetotoxic and caused embryolethality in experimental animal.

Exposure to very high concentrations of benzene [about 20,000 ppm (66,000 mg/m³) in air] can be fatal within minutes. The prominent signs are central nervous system depression and convulsions, with death usually following as a consequence of cardiovascular collapse. Milder exposures can produce vertigo, drowsiness, headache, nausea, and eventually unconsciousness if exposure continues. Deaths from cardiac sensitization and cardiac arrhythmias have also been reported after exposure to unknown concentrations. Although most benzene hazards are associated with inhalation exposure, dermal absorption of liquid benzene may occur, and prolonged or repeated skin contact may produce blistering, erythema, and a dry, scaly dermatitis.

Benzene Page 2 October 1985

Toxicity to Wildlife and Domestic Animals

The EC₅₀ values for benzene in a variety of invertebrate and vertebrate freshwater aquatic species range from 5,300 µg/liter to 386,000 µg/liter. However, only values for the rainbow trout (5,300 µg/liter) were obtained from a flow through test and were based on measured concentrations. Results based on unmeasured concentrations in static tests are likely to underestimate toxicity for relatively volatile compounds like benzene. A chronic test with Daphnia magna was incomplete, with no adverse effects observed at test concentrations as high as 98,000 µg/liter.

For saltwater species, acute values for one fish and five invertebrate species range from 10,900 μ g/liter to 924,000 μ g/liter. Freshwater and saltwater plant species that have been studied exhibit toxic effects at benzene concentrations ranging from 20,000 μ g/liter to 525,000 μ g/liter.

Regulations and Standards

Ambient Water Quality Criteria (USEPA):

Aquatic Life

The available data are not adequate for establishing criteria. However, EPA did report the lowest concentrations of benzene known to cause toxic effects in aquatic organisms.

Freshwater

Acute toxicity: 5,300 µg/liter Chronic toxicity: No available data

Saltwater

Acute toxicity: 5,100 µg/liter Chronic toxicity: No available data

Human Health

Estimates of the carcinogenic risks associated with lifetime exposure to various concentrations of benzene in water are:

Risk	<u>Concentration</u>
10-5 10-6 10-7	6.6 µg/liter 0.66 µg/liter
10	0.066 µg/liter

Benzene Page 3 October 1985 CAG Unit Risk (USEPA): 5.2x10⁻² (mg/kg/day)⁻¹

OSHA Standards: 30 mg/m³ TWA
75 mg/m³ Ceiling Level
150 mg/m³/10 min Peak Concentration

ACGIH Threshold Limit Values: Suspected human carcinogen 30 mg/m³ TWA 75 mg/m³ STEL

REFERENCES

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 ed. Cincinnati, Ohio. 488 pages
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 Benzene in the workplace. Am. Ind. Hyg. Assoc. J. 41:616-623
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 An evaluation of chemicals and industrial processes associated with cancer in humans based on human and animal data.

 IARC Monographs Volumes 1 to 20. Cancer Res. 40:1-12
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 IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Humans. Volume 29: Some Industrial Chemicals and Dyestuffs. World Health Organization, Lyon, France
- NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH).
 1983. Registry of Toxic Effects of Chemical Substances.
 Data Base. Washington, D.C. October 1983
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Benzene Page 4 October 1985

- U.S. ENVIRONMENTAL PROTECTION AGENCY (USEPA). 1980. Ambient Water Quality Criteria for Benzene. Office of Water Regulations and Standards, Criteria and Standards Division, Washington, D.C. October 1980. EPA 440/5-80-018
- U.S. ENVIRONMENTAL PROTECTION AGENCY (USEPA). 1984. Health Effects Assessment for Benzene. Environmental Criteria and Assessment Office, Cincinnati, Ohio. September 1984. ECAO-CIN-HO37 (Final Draft)
- U.S. ENVIRONMENTAL PROTECTION AGENCY (USEPA). 1985. Health Assessment Document for Dichloromethane (Methylene Chloride). Office of Health and Environmental Assessment. Washington, D.C. February 1985. EPA 600/8-82/004F
- WALDRON, H.A. 1979. Target organs: The blood. J. Soc. Occup. Med. 29:65-71

Bromobenzene

Printed August 8, 1990

1 - HSDB

HAZARDOUS SUBSTANCES 47

ATABANK NUMBER

LAST REVISION DATE

890505

NAME OF SUBSTANCE

BROMOBENZENE

CAS REGISTRY NUMBER

108-86-1

SYNONYMS

BENZENE, BROMO- **PEER REVIEWED**

SYNONYMS

MONOBROMOBENZENE **PEER REVIEWED**

SYNONYMS

NCI-C55492 **PEER REVIEWED**

SYNONYMS

PHENYL BROMIDE **PEER REVIEWED**

MOLECULAR FORMULA

C6-H5-Br **QC REVIEWED**

WISWESSER LINE NOTATION

ER **PEER REVIEWED**

RTECS NUMBER

NIOSH/CY9000000

METHODS OF MANUFACTURING REACTION OF BROMINE AND BENZENE IN THE

PRESENCE OF

IRON [SRI] **PEER REVIEWED**

METHODS OF MANUFACTURING PREPD INDUSTRIALLY BY ACTION OF BROMIDE ON BENZENE

IN PRESENCE OF IRON POWDER: GATTERMANN-WIELAND, PRAXIS DES ORGANISCHEN CHEMIKERS (DE GRUYTER, BERLIN, 40TH ED, 1961) 95; ALTERNATE PROCEDURE USING PYRIDENE AS HALOGEN CARRIER: AI VOGEL, PRACTICAL ORG CHEM (LONGMANS, LONDON, 3RD ED,

1959) 535. [The Merck Index. 9th ed. Rahway, New Jersey: Merck & Co., Inc., 1976., p. 181] **QC

REVIEWED**

FORMULATIONS/PREPARATIONS GRADES: TECHNICAL; PURE. [Hawley, G.G. The

Condensed Chemical Dictionary. 9th ed. New York: Van Nostrand Reinhold Co., 1977. , p. 125] **QC REVIEWED**

MAJOR USES

SOLVENT; CHEM INT [SRI] **PEER REVIEWED**

MAJOR USES

IN ORG SYNTHESIS, ESP TO MAKE PHENYL MAGNESIUM

BROMIDE; AS ADDITIVE TO MOTOR OILS; AS SOLVENT,

ESP FOR CRYSTALLIZATIONS ON A LARGE SCALE & WHERE

A HEAVY LIQ IS DESIRABLE [The Merck Index. 9th ed.

Rahway, New Jersey: Merck & Co., Inc., 1976., p.

181] **PEER REVIEWED**

MAJOR USES

MOTOR FUELS; TOP-CYLINDER COMPD [Hawley, G.G. The

Condensed Chemical Dictionary. 9th ed. New York: Van Nostrand Reinhold Co., 1977. , p. 125] **PEER

REVIEWED**

COLOR/FORM

MOBILE LIQUID [The Merck Index. 9th ed. Rahway,

New Jersey: Merck & Co., Inc., 1976., p. 181]

PEER REVIEWED

COLOR/FORM

COLORLESS [U.S. Coast Guard, Department of

Transportation. CHRIS - Hazardous Chemical Data. Manual Two. Washington, DC: U.S. Government Printing Office, Oct., 1978.] **PEER REVIEWED** **ODOR**

AROMATIC ODOR [The Merck Index. 9th ed. Rahway,

New Jersey: Merck & Co., Inc., 1976., p. 181]

QC REVIEWED

BOILING POINT

156.2 DEG C @ 760 MM HG [The Merck Index. 9th ed.

Rahway, New Jersey: Merck & Co., Inc., 1976., p.

181] **PEER REVIEWED**

MELTING POINT

-30.6 DEG C (SOLIDIFIES) [The Merck Index. 9th ed.

Rahway, New Jersey: Merck & Co., Inc., 1976., p.

181] **PEER REVIEWED**

MOLECULAR WEIGHT

157.02 [The Merck Index. 9th ed. Rahway, New

Jersey: Merck & Co., Inc., 1976., p. 181] **PEER

REVIEWED**

CRITICAL TEMPERATURE &

CRITICAL TEMP 397 DEG C; CRITICAL PRESSURE

33,912

PRESSURE

MM HG (44.6 ATM) [The Merck Index. 9th ed. Rahway,

New Jersey: Merck & Co., Inc., 1976., p. 181]

QC REVIEWED

DENSITY/SPECIFIC GRAVITY @ 10 DEG C/4 DEG C: 1.5083; @ 15 DEG C/4 DEG C:

1.5017; @ 20 DEG C/4 DEG C: 1.4952; @ 30 DEG C/4 DEG C: 1.4815; @ 71 DEG C/4 DEG C: 1.426; @ 0 DEG

C/4 DEG C: 1.5220 [The Merck Index. 9th ed. Rahway, New Jersey: Merck & Co., Inc., 1976., p.

181] **QC REVIEWED**

HEAT OF COMBUSTION

-8,510 BTU/LB = -4,730 CAL/G = -198X10+5 JOULES/KG

[U.S. Coast Guard, Department of Transportation. CHRIS - Hazardous Chemical Data. Manual Two. Washington, DC: U.S. Government Printing Office,

Oct., 1978.] **QC REVIEWED**

HEAT OF VAPORIZATIO

104 BTU/LB= 58 CAL/G= 2.4X10+5 JOULES/KG [U.S.

Coast Guard, Department of Transportation. CHRIS -Hazardous Chemical Data. Manual Two. Washington, DC: U.S. Government Printing Office, Oct., 1978.

QC REVIEWED

OCTANOL/WATER PARTITION 1175:1 [YALKOWSKY SH ET AL; IND AND ENG CHEM

COEFFICIENT

FUNDAMENTALS 18: 351 (1979)] **QC REVIEWED**

SOLUBILITIES MISCIBLE WITH CHLOROFORM, BENZENE, PETROLEUM HYDROCARBONS; SOL IN ALCOHOL (10.4 G/100 G @ 25

DEG C), IN ETHER (71.3 G/100 G @ 25 DEG C) [The Merck Index. 9th ed. Rahway, New Jersey: Merck & Co., Inc., 1976., p. 181] **PEER REVIEWED**

SOLUBILITIES

SOL IN CARBON TETRACHLORIDE [Weast, R.C. (ed.).

Handbook of Chemistry and Physics. 60th ed. Boca Raton, Florida: CRC Press Inc., 1979. C-149]

PEER REVIEWED

SOLUBILITIES

0.3597 G/L OF WATER @ 25 DEG C [YALKOWSKY SH ET

AL; IND AND ENG CHEM FUNDAMENTALS 18: 351 (1979)]

PEER REVIEWED

VAPOR DENSITY

5.41 (AIR = 1) [The Merck Index. 9th ed. Rahway,

New Jersey: Merck & Co., Inc., 1976., p. 181]

QC REVIEWED

VAPOR PRESSURE

10 MM HG @ 40 DEG C [Sax, N.I. Dangerous

Properties of Industrial Materials. 5th ed. New York: Van Nostrand Rheinhold, 1979., p. 432]

PEER REVIEWED

VISCOSITY

1.124 CP @ 20 DEG C [The Merck Index. 9th ed.

Rahway, New Jersey: Merck & Co., Inc., 1976., p.

181] **QC REVIEWED**

OTHER CHEMICAL/PHYSICAL

HEAT OF MELTING 16.186 CAL/G @ 15 DEG C;

SPECIFIC

PROPERTIES

HEAT @ 26.84 DEG C: 0.2368 [The Merck Index. 9th

ed. Rahway, New Jersey: Merck & Co., Inc., 1976.,

p. 181] **QC REVIEWED**

OTHER CHEMICAL/PHYSICAL

SICAL WT/GAL 12.51 LB [Hawley, G.G. The Condensed

PROPERTIES

Chemical Dictionary. 9th ed. New York: Van

Nostrand Reinhold Co., 1977., p. 125] **QC

REVIEWED**

OTHER CHEMICAL/PHYSICAL PROPERTIES DYNES

L LIQUID-WATER INTERFACIAL TENSION: (EST) 30

DYNES/= 0.030 NEWTONS/M @ 20 DEG C [U.S. Coast

Guard, Department of Transportation. CHRIS -

Hazardous Chemical Data. Manual Two. Washington,

DC: U.S. Government Printing Office, Oct., 1978.

QC REVIEWED

NFPA HAZARD

HEALTH 2: 2= MATERIALS HAZARDOUS TO HEALTH, BUT CLASSIFICATION AREAS MAY BE ENTERED FREELY WITH FULL-FACED MASK SELF-CONTAINED BREATHING APPARATUS WHICH PROVIDES EYE PROTECTION. [National Fire Protection

Association. Fire Protection Guide on Hazardous Materials. 7th ed. Boston, Mass.: National Fire Protection Association, 1978. 325M-37] **QC REVIEWED**

NFPA HAZARD CLASSIFICATION

FLAMMABILITY 2; 2= MATERIALS WHICH MUST BE MODERATELY HEATED BEFORE IGNITION WILL OCCUR.

WATER SPRAY MAY BE USED TO EXTINGUISH THE FIRE

BECAUSE THE MATERIAL CAN BE COOLED BELOW ITS FLASH

POINT. [National Fire Protection Association. Fire Protection Guide on Hazardous Materials. 7th ed.

Boston, Mass.: National Fire Protection

Association, 1978. 325M-37] **PEER REVIEWED**

NFPA HAZARD CLASSIFICATION

REACTIVITY 0: 0 = MATERIALS WHICH (IN THEMSELVES) ARE NORMALLY STABLE EVEN UNDER FIRE EXPOSURE

CONDITIONS & WHICH ARE NOT REACTIVE WITH WATER. NORMAL FIRE FIGHTING PROCEDURE MAY BE USED.

[National Fire Protection Association. Fire

Protection Guide on Hazardous Materials. 7th ed.

Boston, Mass.: National Fire Protection

Association, 1978. 325M-37] **QC REVIEWED**

FLASH POINT

51 DEG C (123.8 DEG F) [The Merck Index. 9th ed.

Rahway, New Jersey: Merck & Co., Inc., 1976., p.

181] **PEER REVIEWED**

AUTOIGNITION TEMPERATURE 1051 DEG F [Sax, N.I. Dangerous Properties of

Industrial Materials. 5th ed. New York: Van Nostrand Rheinhold, 1979., p. 432] **QC **REVIEWED****

SKIN, EYE AND RESPIRATORY IRRITANT TO SKIN. [Gosselin, R.E., H.C. Hodge, IRRITATIONS R.P. Smith, and M.N. Gleason. Clinical Toxicology

of Commercial Products. 4th ed. Baltimore: Williams and Wilkins, 1976. II-114] **QC

REVIEWED**

PROTECTIVE EQUIPMENT & GOGGLES OR FACE SHIELD; RUBBER GLOVES & APRON.

CLOTHING

[U.S. Coast Guard, Department of Transportation. CHRIS - Hazardous Chemical Data. Manual Two.

Washington, DC: U.S. Government Printing Office.

Oct., 1978.] **PEER REVIEWED**
(ATING 4 (?). 4 = VERY TOXIC: PROBABLE ORAL LETHAL DOSE TOXIC HAZARD RATING...

(HUMAN) IS 50-500 MG/KG, BETWEEN 1 TEASPOON & 1 OUNCE FOR 70 KG PERSON (150 LB). [Gosselin, R.E.,

H.C. Hodge, R.P. Smith, and M.N. Gleason. Clinical

Toxicology of Commercial Products, 4th ed. Baltimore: Williams and Wilkins, 1976. II-114]

PEER REVIEWED

THE FOLLOWING OVERVIEW IS A SUMMARY. CONSULT THE COMPLETE POISINDEX (R)

DATABASE FOR TREATMENT PURPOSES. COPYRIGHT 1974-YEAR MICROMEDEX, INC.

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EMERGENCY MEDICAL

TREATMENT

LIFE SUPPORT:

This overview assumes that basic life support measures have been instituted.

CLINICAL EFFECTS:

SUMMARY

- o SUMMARY: It is important to remember to treat the patient, not his poison. Symptomatic and supportive care is the mainstay of therapy (Saddique et al, 1986).
- o An approach to an unknown poison is to:
- 1. First assess the substance in question as well as the route of administration for potential toxicity (Nicholson, 1983).
- 2. Second, support vital functions and monitor cardiac status, vital signs, fluid intake and output, body temperature, and determine if a Swan-Ganz catheter is indicated to monitor pulmonary wedge pressure

(Nicholson, 1983).

- 3. Third (oral exposures especially), prevent absorption by various combinations of emetics, lavage, cathartics, or adsorbents (Saddique et al, 1986).
- 4. Appropriate laboratory tests should be ordered (Nicholson, 1983).
- 5. Assess the patient's level of consciousness (Nicholson, 1983).
- o Symptoms seen due to unknown poisons may occur to any of the body systems, and a thorough diagnostic evaluation should be performed on any patient involved in exposure to an unknown agent.

LABORATORY:

o There are various laboratory tests and screens available for compounds and groups of compounds. In cases of unknown ingestion, it is important to consult a competent analytical chemist so that correct samples can be drawn to obtain the widest variety of compounds with the minimum number of samples. As part of the consult with the chemist, symptoms, and suspicions from the history should be discussed. In this matter the chemist can help pick appropriate screens and not waste time on poisons that do not fit the symptomatology. Blood, urine, and gastric contents may be potential samples and should be saved until after the consult with the anatical chemist.

TREATMENT OVERVIEW:

SUMMARY

- o This management is intended for use in the absence of a specific treatment protocol for a product, drug or chemical. It should be used when an agent is not listed in the file and some guidelines may be needed for patient care. It may also be helpful when an experimental agent has been ingested and there is no data available on its toxicity.
- o Remember that up to 50% of all initial histories are incorrect and that history should be obtained from several individuals if possible. Important information to be obtained from products includes the type of packaging, the amount in the package, and the amount remaining after ingestion.
- o In first examining the patient remember to:
- 1. Assess life threatening potential.
- 2. Cardiopulmonary stabilization is mandatory.
- 3. If the patient is comatose or seizing, dextrose, naloxone, and oxygen should immediately be administered.

- 4. Appropriate laboratory samples should be taken.
- 5. Serial examinations should be performed to chart whether the patient is improving or deteriorating.

ORAL EXPOSURE

- o The goal is to remove, detoxify, or prevent absorption of ingested substances. Which of the following measures is appropriate will depend somewhat on the patients symptomatology and the possible ingestants involved.
- o EMESIS: May be indicated in recent substantial ingestion unless the patient is or could rapidly become obtunded, comatose or convulsing. Is most effective if initiated within 30 minutes. (Dose of Ipecac Syrup: ADULT: 30 mL; CHILD 1 to 12 years: 15 mL).
- o GASTRIC LAVAGE: May be indicated if performed soon after ingestion, or in patients who are comatose or at risk of convulsing. After control of any seizures present, perform gastric lavage. Protect airway by placement in Trendelenburg and left lateral decubitus position or by cuffed endotracheal intubation. Lavage return should approximate fluid given.
- o ACTIVATED CHARCOAL/CATHARTIC: Administer charcoal slurry, aqueous or mixed with saline cathartic or sorbitol. Usual charcoal dose: 30 to 100 g in adults and 15 to 30 g in children (1 to 2 g/kg in infants). Administer one dose of a cathartic, mixed with charcoal or given separately. See Section 5.3.1. for doses.
- o WHOLE GUT LAVAGE: Has been utilized as alternative methods for G.I. decontamination. The use of whole gut lavage in the management of poison patients is currently controversial. Potential hypertonic solutions for use include Colyte(R) and Golytely(R).
- o INTRAVENOUS-ENVENOMATION PROCEDURES: There is little that can be done to eliminate exposure to toxins administered intravenously or by envenomation. Procedures such as fasciectomy and fasciotomy are recommended when documented pressure myolysis is function-threatening.
- TREATMENT IN GENERAL
- 1. Establishment of respirtion and the creation of an artificial airway is necessary.
- 2. Treat hypotension with fluids or plasma try to avoid vasopressors if possible.
- 3. HYPOTENSION: Administer IV fluids and place in Trendelenburg position. If unresponsive to these measures, administer dopamine (2 to 5 mcg/kg/min) or norepinephrine (0.1 to 0.2 mcg/kg/min) and titrate as needed to desired response.
- 4. Coma should be treated in an appropriate manner regardless of the suspected cause. Attention should be paid to respiration and circulation. The use of

- naloxone may be recommended if the coma is due to opioids or is of unknown origin. It does not cause respiratory paralysis.
- 5. Monitory cerebral intraventricular pressure and restrict fluids, or administer mannitol or furosemide if hypotension is not induced in cases of postanoxic cerebral edema/hyperthermia. Corticosteroids may be of some use. Enhanced elimination may be done by forced diuresis, alkaline forced diuresis, dialysis, or exchange transfusion.

INHALATION EXPOSURE

- o DECONTAMINATION: Move patient to fresh air. Monitor for respiratory distress; if cough or difficulty in breathing develops, evaluate for respiratory tract irritation, bronchitis, or pneumonitis. Administer 100% humidified supplemental oxygen with assisted ventilation as required.
- o Carefully observe patients with inhalation exposure for the development of any systemic signs or symptoms and administer symptomatic treatment as necessary.

EYE EXPOSURE

o DECONTAMINATION: Exposed eyes should be irrigated with copious amounts of tepid water for at least 15 minutes. If irritation, pain, swelling, lacrimation, or photophobia persist, the patient should probably be seen in a health care facility.

DERMAL EXPOSURE

o DECONTAMINATION: Wash exposed area extremely thoroughly with soap and water. A physician may need to examine the area if irritation or pain persist.

RANGE OF TOXICITY:

o In many cases the amount of toxin ingested will be unknown, or the milligram/kilogram toxicity of the agent itself will be uncertain. As stated above, it is the patient, not the poison which should be treated in these cases, and until the toxic substance or the substances toxicity has been more accurately determined the amount ingested will have less relevance than the patients clinical condition.

REFERENCE: [Rumack BH & Spoerke DG: POISINDEX(R) Information System. Micromedex Inc., Denver, CO, 1990; CCIS CD-ROM Volume 65, edition exp September, 1990.] **PEER REVIEWED**

ANTIDOTE AND EMERGENCY ROCKY MOUNTAIN POISON CENTER IS WIDELY KNOWN FOR

TREATMENT FOR

EXPERTISE IN TREATING ACETAMINOPHEN OVERDOSE.

FURTHER INFORMATION AND CONSULTATION, CALL (800)

525-5115. [CITATION] **PEER REVIEWED**

HUMAN TOXICITY EXCERPTS IRRITANT TO SKIN. HIGH VAPOR CONCN MAY BE

ANESTHETIC. [Gosselin, R.E., H.C. Hodge, R.P. Smith, and M.N. Gleason. Clinical Toology of

Commercial Products. 4th ed. Baltimore: Williams

and Wilkins, 1976. II-114] **PEER REVIEWED**

HUMAN TOXICITY EXCERPTS HEPATIC CENTRILOBULAR NECROSIS INDUCED BY BROMOBENZENE IS THOUGHT TO BE CAUSED BY FORMATION

OF BROMOBENZENE.../PRC: OXIDES & THEIR/ SUBSEQUENT

REACTION WITH LIVER PROTEINS, THE PRODUCTS OF WHICH CAN BE FOUND IN NECROTIC AREAS OF LIVER.

[The Chemical Society. Foreign Compound Metabolism in Mammals Volume 3. London: The Chemical Society.

1975., p. 530] **PEER REVIEWED**

HUMAN TOXICITY EXCERPTS NO HUMAN POISONINGS ARE KNOWN, BUT AS WITH CARBON

TETRACHLORIDE MAN MAY BE AN UNUSUALLY SUSCEPTIBLE

SPECIES. [Gosselin, R.E., H.C. Hodge, R.P. Smith,

and M.N. Gleason. Clinical Toxicology of

Commercial Products. 4th ed. Baltimore: Williams and Wilkins, 1976. II-114] **PEER REVIEWED**

HUMAN TOXICITY EXCERPTS ...NO EVIDENCE THAT BROMOBENZENE IS CARCINOGENIC

IN...MAN. [National Research Council. Drinking Water & Health Volume 1. Washington, DC: National Academy Press, 1977., p. 695] **PEER REVIEWED**

NON-HUMAN TOXICITY DOGS TOLERATED ORAL...3-5 G SEVERAL DAYS
EXCERPTS BEFORE VOMITING DIARRHEA & EVENTUALLY DEAT

BEFORE...VOMITING, DIARRHEA & EVENTUALLY DEATH.
RATS GIVEN 3 G/KG SHOWED TOXIC SYMPTOMS AFTER 6-10

DAYS... WIDESPREAD HEPATIC NECROSIS NOT ONLY AROUND CENTROLOBULAR VEINS BUT ALSO AROUND ALL

TRIBUTARIES OF THE HEPATIC VEINS. LESIONS RESEMBLE

THOSE.../OF/ THIOACETAMIDE & TANNIC ACID.

[Gosselin, R.E., H.C. Hodge, R.P. Smith, and M.N.

Gleason. Clinical Toxicology of Commercial Products. 4th ed. Baltimore: Williams and Wilkins,

1976. II-114] **PEER REVIEWED**

NON-HUMAN TOXICITY

...IN AN INHALATION STUDY IN RATS,

BROMOBENZENE

EXCERPTS WAS ADMIN DAILY FOR 4-HR PERIOD @ 3 UG/CU M,

WITHOUT TOXIC EFFECTS; 20 UG/CU M WAS A DEFINITE-EFFECT DOSAGE IN SIMILAR TESTS...

BROMOBENZENE WAS NOT MUTAGENIC IN

SALMONELLA/MICROSOME TEST... THERE IS NO EVIDENCE THAT BROMOBENZENE IS CARCINOGENIC IN ANIMALS...

[National Research Council. Drinking Water &

Health Volume 1. Washington, DC: National Academy

Press, 1977., p. 695] **PEER REVIEWED**

NON-HUMAN TOXICITY REPEATED EXPOSURE OF RATS TO...250 MG/CU M

CAUSED

EXCERPTS

NERVOUS SYSTEM DISORDERS &... (NEUTROPHIL LEUKOPENIA & LYMPHOPENIA). ...EXPOSED TO...20 MG/CU M...FOR 4.5 MO...ARRESTED

GROWTH...INHIBITION OF NERVOUS SYSTEM, DISORDERS OF LIVER FUNCTION & REDN OF SULFHYDRYL GROUPS IN SERUM & LIVER HOMOGENATE.../& IN/ SERUM ALBUMIN CONCN. [International Labour Office. Encyclopedia of Occupational Health and Safety. Volumes I and

II. New York: McGraw-Hill Book Co., 1971., p.

212] **PEER REVIEWED**

NON-HUMAN TOXICITY

TIME COURSE & ACINAR DISTRIBUTION OF

EXCERPTS BROMOBENZENE-INDUCED HEPATIC NECROSIS: LIGHT & ELECTRON MICROSCOPY IN RAT. ZONE 3 SHOWED

CONFORMATIONAL CHANGES IN SMOOTH ENDOPLASMIC

RETICULUM 6 HR AFTER ADMIN, & HEPATOCYTE

CYTOPLASMIC VACUOLAR DEGENERATION & NECROSIS @ 48 HR. [MILLER DL ET AL; BROMOBENZENE-INDUCED ZONAL NECROSIS IN THE HEPATIC ACINUS; EXP MOL PATHOL

29(3) 358 (1978)] **PEER REVIEWED**

NON-HUMAN TOXICITY

IN ISOLATED RAT HEPATOCYTES BROMOBENZENE

METAB LED

EXCERPTS

TO GSH DEPLETION, PROGRESSIVE DECR IN COENZYME A

&

NICOTINAMIDE NUCLEOTIDE LEVELS & MODERATE INCR IN FORMATION OF METABOLITES COVALENTLY BOUND TO PROTEIN. [THOR H ET AL, METABOLIC ACTIVATION AND HEPATOTOXICITY: TOXICITY OF BROMOBENZENE IN HEPATOCYTES ISOLATED FROM PHENOBARBITAL- AND DIETHYLMALEATE-TREATED RATS; ARCH BIOCHEM BIOPHYS 188(1) 122 (1978)] **PEER REVIEWED***

NON-HUMAN TOXICITY

BROMOBENZENE AT A DOSE OF 5.0 MMOL/KG, IP,

INCR

EXCERPTS

BILE DUCT-PANCREATIC FLUID FLOW AND DECR ITS PROTEIN CONCN 24 HR AFTER TREATMENT OF RATS. [YANG KH ET AL; INCREASED BILE DUCT-PANCREATIC FLUID FLOW IN BENZENE AND HALOGENATED BENZENE-TREATED RATS; TOXICOL APPL PHARMACOL 47(3) 505 (1979)]

PEER REVIEWED

NON-HUMAN TOXICITY EXCERPTS I

CICITY THE HEPATOTOXIC EFFECT OF BROMOBENZENE AS DETERMINED BY SERUM ENZYME ACTIVITY WAS INVESTIGATED IN NORMALLY FED AND 24-HR FASTED MICE. FASTING ENHANCED SERUM ENZYME ELEVATIONS. [STRUBELT O ET AL; INFLUENCE OF FASTING ON THE SUSCEPTIBILITY OF MICE TO HEPATOTOXIC INJURY; TOXICOL APPL PHARMACOL 60(1) 66 (1981)] **PEER REVIEWED**

NON-HUMAN TOXICITY

IN RATS, IP ADMIN OF BROMOBENZENE DECR

GLUTATHIONE

EXCERPTS

LEVELS IN LIVER AND KIDNEY BEFORE DOUBLING THE METALLOTHIONEIN CONCN IN THE LIVER AND INCR THAT

IN KIDNEYS BY 40% STARTING FROM 6 HR AFTER ADMIN. [WONG K-L, KLAASSEN CD; RELATIONSHIP BETWEEN LIVER AND KIDNEY LEVELS OF GLUTATHIONE AND METALLOTHIONEIN IN RATS; TOXICOLOGY 19(1) 39 (1981)] **PEER REVIEWED**

NON-HUMAN TOXICITY

AFTER ORAL ADMIN OF 1.5 OR 3.0 G/KG

BROMOBENZENE

EXCERPTS

IN HAMSTERS, A DECR OF AMINOPYRINE N-DEMETHYLASE AS WELL AS AN INCR OF HYDROPEROXIDE FORMATION OCCURRED. AT 3.0 G/KG, MOST MIXED-FUNCTION OXIDASE WAS INHIBITED WITH THE EXCEPTION OF KETAMINE N-DEMETHYLASE, METHYLAYAPANINE O-DEMETHYLASE, AND COUMARIN 7-HYDROXYLASE. LIPOPEROXIDAON WAS REDUCED. [MAYER DG, BEYHL FE; STUDIES ON LIVER TOXICANTS: INFLUENCE OF BROMOBENZENE ON HEPATIC MICROSOMAL DRUG-METABOLIZING ENZYMES IN THE HAMSTER; TOXICOL LETT 16(1-2) 89 (1983)] **PEER REVIEWED**

WATER CONCENTRATIONS

DURING CHLORINATION WATER TREATMENT, BROMOBENZENE CAN BE FORMED IN SMALL QUANTITIES.../HAS BEEN/ FOUND IN FINISHED WATER IN LOWER MISSISSIPPI RIVER AREA... [National Research Council. Drinking Water

& Health Volume 1. Washington, DC: National Academy Press, 1977., p. 693] **PEER REVIEWED**

T-Butylbenzene

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- HSDB
HSN - 5315
DATE - 891120
UPDT - Complete Update on 11/20/89, 6 fields added/edited/deleted.
UPDT - Complete Update on 01/14/85
RLEN - 8212
NAME - T-BUTYLBENZENE
RN - 98-06-6
SY - (1,1-DIMETHYLETHYL)BENZENE **PEER REVIEWED**
     - 2-METHYL-2-PHENYLPROPANE **PEER REVIEWED**
     - BENZENE, (1,1-DIMETHYLETHYL)- **PEER REVIEWED**
- BENZENE, TERT-BUTYL- **PEER REVIEWED**
     - DIMETHYLETHYLBENZENE( **PEER REVIEWED**
- PHENYLTRIMETHYLMETHANE **PEER REVIEWED**
      - PSEUDOBUTYLBENZENE **PEER REVIEWED**
      - TERT-BUTYLBENZENE **PEER REVIEWED**
      - TRIMETHYLPHENYLMETHANE **PEER REVIEWED**
     - C10-H14 **PEER REVIEWED**
WLN - 1X1&1&R **PEER REVIEWED**
RTEC - NIOSH/CY9120000
MMFG - PREPD FROM BENZENE, ISOBUTYL CHLORIDE AND ALCL3: KONOWALOW, BULL SOC
      CHIM [3]16 865 (1896); SHOESMITH, MACKIE, J CHEM SOC 2336 (1928); FROM ISOBUTYL ALCOHOL AND BENZENE BY TREATMENT WITH FUMING SULFURIC ACID:
      MEYER, BERNHAUER, MONATSH 53: 727 (1929)... [MERCK INDEX 9TH ED 1976,
      p. 198] **PEER REVIEWED**
MMFG - ...BY DECARBONYLATION OF BETA-PHENYLISOVALERALDEHYDE IN PRESENCE OF PD/C CATALYST; WILT, ABEGG, J ORG CHEM 33: 923 (1968). SEE ALSO GROOSE, IPATIEFF, J AM CHEM SOC 57: 2415 (1935); IPATIEFF, PINES, J AM CHEM SOC 58: 1056 (1936). [MERCK INDEX 9TH ED 1976, p. 198] **PEER REVIEWED**

MMFG - PROBABLY BY REACTION OF BENZENE WITH ISOBUTYL OR T-BUTYL CHLORIDE IN
      THE PRESENCE OF ALUMINUM CHLORIDE [SRI ] **PEER REVIEWED**
MMFG - By the action of sodium on gamma-chloro-sec-butylbenzene: Braun et al,
Ber. 46, 1277 (1913) [MERCK INDEX 10TH ED 1983 p.216] **QC REVIEWED**
FORM - GRADES: TECHNICAL; PURE; RESEARCH. [HAWLEY. CONDENSED CHEM DICTNRY 9TH
      ED 1977, p. 135] **PEER REVIEWED**
MFS - PHILLIPS PETROLEUM CO, PHILLIPS CHEM CO, SUBSID, PETROCHEMS DIV,
BORGER, TX 79007 [SRI] **PEER REVIEWED**
USE - IN ORGANIC SYNTHESIS; POLYMERIZATION SOLVENT; POLYMER LINKING AGENT
[HAWLEY. CONDENSED CHEM DICTNRY 9TH ED 1977, p. 135] **PEER REVIEWED**
USE - SOLVENT, EG, IN PRODN OF HYDROGEN PEROXIDE [SRI] **PEER REVIEWED**
CPAT - ND [SRI] **PEER REVIEWED**
PROD - (1979) PROBABLY GREATER THAN 2.27X10+6 GRAMS [SRI ] **PEER REVIEWED**
PROD - (1981) PROBABLY GREATER THAN 2.27X10+6 GRAMS [SRI ] **PEER REVIEWED**
IMPT - (1979) 8.46X10+5 GRAMS (PRINCPL CUSTMS DISTS) [SRI] **PEER REVIEWED**
IMPT - (1981) 4.80X10+7 GRAMS (PRINCPL CUSTMS DISTS) [SRI] **PEER REVIEWED**
EXPT - (1979) ND [SRI ] **PEER REVIEWED**
EXPT - (1981) ND [SRI ] **PEER REVIEWED**
COFO - LIQUID [MERCK INDEX 9TH ED 1976, p. 198] **PEER REVIEWED**
COFO - COLORLESS [HAWLEY. CONDENSED CHEM DICINRY 9TH ED 1977, p. 135] **PEER
      REVIEWED**
      - 168.5 DEG C @ 760 MM HG [MERCK INDEX 9TH ED 1976, p. 198] **PEER
      REVIEWED**
      - -58.1 DEG C [MERCK INDEX 9TH ED 1976, p. 198] **PEER REVIEWED**
MW - 134.21 **PEER REVIEWED**
DEN - 0.8669 @ 20 DEG C/4 DEG C [MERCK INDEX 9TH ED 1976, p. 198] **PEER
      REVIEWED*
SOL - INSOL IN WATER; MISCIBLE WITH ALC, ETHER, BENZENE [MERCK INDEX 9TH ED
      1976, p. 198] **PEER REVIEWED**
SOL - SOL IN ALL PROP IN ACETONE, PETROLEUM ETHER, CARBON TETRACHLORIDE
      [WEAST. HDBK CHEM & PHYS 60TH ED 1979 C-152] **PEER REVIEWED**
SPEC - INDEX OF REFRACTION: 1.49235 @ 20 DEG C/D [MERCK INDEX 9TH ED 1976, p.
      198] **PEER REVIEWED**
SPEC - MAX ABSORPTION (HEXANE): 253 NM (LOG E= 2.2); 257 NM (LOG E= 2.3); 264
      NM (LOG E= 2.2), SHOULDER; 267 NM (LOG E= 2.1) [WEAST. HDBK CHEM & PHYS 60TH ED 1979 C-152] **PEER REVIEWED**
VAPD - 4.62 (AIR = 1) [PATTY. INDUS HYG & TOX 3RD ED VOL2A,2B,2C 1981-82, p. 3256] **PEER REVIEWED**
VAP - 5.7 MM HG @ 37.8 DEG C [PATTY. INDUS HYG & TOX 3RD ED VOL2A,2B,2C 1981-82 , p. 3257] **PEER REVIEWED**
OCPP - ODOROUS /MONOBUTYLBENZENES/ [PATTY. INDUS HYG & TOX 3RD ED VOL2A,2B,2C
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1981-82 , p. 3311] **PEER REVIEWED.**

OCPP - WT/VOL CONVERSION: 5.49 MG/CU M = 1PPM (PATTY, INDUS HYG & TOX 3RD ED

VOL2A,2B,2C 1981-82, p. 3256] **PEER REVIEWED**

NFPA - HEALTH = 2. 2= MATERIALS HAZARDOUS TO HEALTH, BUT AREAS MAY BE ENTERED FREELY WITH FULL-FACED MASK SELF-CONTAINED BREATHING APPARATUS WHICH PROVIDES EYE PROTECTION. [NFPA. FIRE PROTECT GUIDE HAZARD MATLS. 1978 325M-41| **PEER REVIEWED**

NFPA - FLAMMABILITY = 2. 2 = MATERIALS WHICH MUST BE MODERATELY HEATED BEFORE IGNITION WILL OCCUR. WATER SPRAY MAY BE USED TO EXTINGUISH THE FIRE BECAUSE THE MATERIAL CAN BE COOLED BELOW ITS FLASH POINT. [NFPA. FIRE

PROTECT GUIDE HAZARD MATLS. 1978 325M-41] **PEER REVIEWED**
NFPA - REACTIVITY = 0. 0 = MATERIALS WHICH (IN THEMSELVES) ARE NORMALLY STABLE EVEN UNDER FIRE EXPOSURE CONDITIONS AND WHICH ARE NOT REACTIVE WITH WATER. NORMAL FIRE FIGHTING PROCEDURES MAY BE USED. INFPA. FIRE PROTECT GUIDE HAZARD MATLS. 1978 325M-41] **PEER REVIEWED**
FLMT - 0.7%-5.7% @ 100 DEG C [NFPA. FIRE PROTECT GUIDE HAZARD MATLS. 1978

325M-41] **PEER REVIEWED**

FLPT - 60 DEG C OC [NFPA. FIRE PROTECT GUIDE HAZARD MATLS. 1978 325M-41] **PEER REVIEWED**

AUTO - 450 DEG C [NFPA. FIRE PROTECT GUIDE HAZARD MATLS. 1978 325M-41] **PEER REVIEWED**

EXPL - THE TEMP RANGE FOR SMOOTH INTERACTION OF BROMOBENZENE, 1-BROMOBUTANE AND SODIUM IN ETHER TO GIVE BUTYLBENZENE IS CRITICAL BELOW 15 DEG C REACTION IS DELAYED BUT LATER BECOMES VIGOROUS, AND ABOVE 30 DEG C THE REACTION BECOMES VIOLENT. [BRETHERICK. HDBK REAC CHEM HAZARD 2ND ED 1979, p. 690] **PEER REVIEWED**

NTOX - IN RAT LIVER LYSOSOMES AND MITOCHONDRIA, TERT-BUTYL BENZENE INCREASED THE LIBERATION OF PROTEINS AND ACID PHOSPHATASE ACTIVITY 4 AND 11 TIMES, RESPECTIVELY, INCR THE AMT OF GLUTAMIC DEHYDROGENASE (GLU-DH) ACTIVITY 5 TIMES, & INHIBITED THE FORMATION OF LIPID PEROXIDES SIGNIFICANTLY. [SCARAGLI GP ET AL; TOXICITY OF FOOD ADDITIVES: II.

DAMAGE OF MEMBRANES INDUCED BY MONOCYCLIC COMPOUNDS ON MITOCHONDRIA AND LYSOSOMES OF RAT LIVER: STRUCTURE-ACTION CORRELATION; BOLL SOC ITAL

BIOL SPER 51(22) 1702 (1975)] **PEER REVIEWED**
NTOX - WHEN THE EFFECT OF TERT-BUTYLBENZENE (1 MMOL CONCN) ON MITOCHONDRIAL OXIDATION OF GLUTAMATE, SUCCINATE AND MALATE IN PRESENCE OF OXYGEN IN RAT LIVER MITOCHONDRIA WAS STUDIED, IT REDUCED RESPIRATION BY 30%. [SCARAGLI GP ET AL; TOXICITY OF FOOD ADDITIVES: III. INHIBITION OF

[SCARAGLI GP ET AL; TOXICITY OF FOOD ADDITIVES: III. INHIBITION OF RESPIRATORY FUNCTION INDUCED BY BHA AND BHT ON MITOCHONDRIA OF RAT LIVER; BOLL SOC ITAL BIOL SPER 51(22) 1707 (1975)] **PEER REVIEWED**

METB - YIELDS 2,2-DIMETHYL-2-PHENYLETHANOL IN RABBIT; CHAKRABORTY, J & SMITH, JN; BIOCHEM J 102: 498 (1967). /FROM TABLE/ [GOODWIN. HDBK INTERMED METAB AROMAT COMPD 1976 B-27] **PEER REVIEWED**

METB - .../MONOBUTYLBENZENES/ ARE BELIEVED TO BE READILY METABOLIZED BY SIDE

CHAIN HYDROXYLATION AND CONJUGATION FOR URINARY EXCRETION. [PATTY. INDUS HYG & TOX 3RD ED VOL2A,2B,2C 1981-82, p. 3311] **PEER REVIEWED**

METB - FROM CULTURES OF ACHROMOBACTER STRAINS A2 IN THE PRESENCE OF TERT-BUTYLBENZENE, A DIOL WAS ISOLATED AND IDENTIFIED AS 2,3-DIHYDRO-2,3-DIHYDROXY-TERT-BUTYLBENZENE. EVIDENCE FOR META CLEAVAGE OF THE AROMATIC RING AND FOR ACCUMULATION OF PIVALIC ACID IN THE CULTURES WAS ALSO OBTAINED. [CATELANI D ET AL; METABOLISM OF QUATERNARY CARBON COMPOUNDS: 2,2-DIMETHYLHEPTANE AND TERTBUTYLBENZENE; APPL

ENVIRON MICROBIOL 34(4) 351 (1977)] **PEER REVIEWED**

ALAB - DETERMINATION OF TERT-BUTYLBENZENE BY GAS CHROMATOGRAPHY. [BABINA MD;
GAS CHROMATOGRAPHIC DETERMINATION OF SOME MICRO IMPURITIES ENTERING THE
AIR IN PRODUCTION OF SOME STYRENE CO POLYMERS; GIG TR PROF ZABOL 0(3) 55 (1979)] **PEER REVIEWED**

2-Chlorotoluene

Printed August 8, 1990

- HSDB HAZARDOUS SUBSTANCES 5291 DATABANK NUMBER LAST REVISION DATE 900404 REVIEW DATE Reviewed by SRP on 05/20/88 NAME OF SUBSTANCE 2-CHLOROTOLUENE CAS REGISTRY NUMBER 95-49-8 2-CHLORO-1-METHYLBENZENE **PEER REVIEWED** SYNONYMS SYNONYMS 2-CHLOROTOLUENE **PEER REVIEWED** O-CHLOROTOLUENE **PEER REVIEWED** SYNONYMS O-TOLYL CHLORIDE **PEER REVIEWED** SYNONYMS SYNONYMS ORTHO-CHLOROTOLUENE **PEER REVIEWED** **SYNONYMS** TOLUENE, O-CHLORO- **PEER REVIEWED** SYNONYMS 1-METHYL-2-CHLOROBENZENE **PEER REVIEWED** MOLECULAR FORMULA C7-H7-Cl **PEER REVIEWED** MONOCHLOROTOLUENE, 60% ORTHO & 40% PARA OTHER MANUFACTURING INFORMATION IS PRODUCED ISOMERS, COMMERCIALLY. /MONOCHLOROTOLUENE/ [American Conference of Governmental Industrial Hygienists. Documentation of the Threshold Limit Values and Biological Exposure Indices. 5th ed. Cincinnati, OH: , p. 137] **PEER REVIEWED** **MAJOR USES** SOLVENT; DYESTUFF INTERMEDIATE; IN ORG SYNTHESES The Merck Index. 10th ed. Rahway, New Jersey: Merck Co., Inc., 1983., p. 306] **PEER REVIEWED** **MAJOR USES** INSECTICIDE & BACTERICIDE [JPN KOKAI TOKKYO KOHO PATENT NO 81 71004 (6/13/81) (HODOGAYA CHEMICAL CO, LTD)] **PEER REVIEWED** DISINFECTANT FOR COCCIDIOSIS CONTROL [TSUNODA K, MAJOR USES HIRAKOSO J; JPN KOKAI PATENT NO 73 36320 (5/29/73) (CHUO KAGAKU & CO)] **PEER REVIEWED** COLOR/FORM COLORLESS LIQUID [Sax, N.I. and R.J. Lewis, Sr. (eds.). Hawley's Condensed Chemical Dictionary. 11th ed. New York: Van Nostrand Reinhold Co., 1987., p. 273] **PEER REVIEWED** 158.97 DEG C [The Merck Index. 10th ed. Rahway, **BOILING POINT** New Jersey: Merck Co., Inc., 1983., p. 306] **PEER REVIEWED** -35.1 DEG C [Weast, R.C. (ed.) Handbook of **MELTING POINT** Chemistry and Physics, 68th ed. Boca Raton, Florida: CRC Press Inc., 1987-1988. C-518] **PEER **REVIEWED**** MOLECULAR WEIGHT 126.6 [American Conference of Governmental Industrial Hygienists. Documentation of the

DENSITY/SPECIFIC GRAVITY 1.0826 @ 20 DEG C/4 DEG C [The Merck Index. 10th

Threshold Limit Values and Biological Exposure Indices. 5th ed. Cincinnati, OH: , p. 137] **PEER

REVIEWED**

ed. Rahway, New Jersey: Merck Co., Inc., 1983.,

p. 306] **PEER REVIEWED**

OCTANOL/WATER PARTITION Log Kow = 3.42 [Hansch, C. and A. Leo. The Log P

COEFFICIENT Database. Claremont, CA: Pomona College, June

1984.] **PEER REVIEWED**

SOLUBILITIES

FREELY SOL IN ALCOHOL, BENZENE, CHLOROFORM, ETHER

[The Merck Index. 10th ed. Rahway, New Jersey:

Merck Co., Inc., 1983., p. 306] **PEER REVIEWED**

SOLUBILITIES SOL IN ACETONE, CARBON TETRACHLORIDE [Weast, R.C. (ed.) Handbook of Chemistry and Physics, 68th ed.

Boca Raton, Florida: CRC Press Inc., 1987-1988.

C-518] **PEER REVIEWED**

SOLUBILITIES Solubility less than 10% in acetone, benzene,

ether, alcohol [Weast, R.C. and M.J. Astle. CRC Handbook of Data on Organic Compounds. Volumes I and II. Boca Raton, FL: CRC Press Inc. 1985. V2

362] **PEER REVIEWED**

SOLUBILITIES Water solubility of 89 mg/l at 25 deg C [Hansch C,

> Leo AJ; Medchem Project Issue No. 26 Claremont, CA: Pomona College (1985) Lyman WJ et al; p. 5-5

in Handbook of Chemical Property Estimation

Methods NY: McGraw-Hill (1982)] **PEER REVIEWED**

VAPOR PRESSURE

3.6 mm Hg at 25 deg C [Riddick JA et al; Organic

Solvents: Physical Properties and Methods of Purification 4th ed NY: Wiley-Interscience p. 483

(1986)] **PEER REVIEWED**

The major hazards encountered in the use and HAZARDS SUMMARY

handling of 2-chlorotoluene stem from its toxicologic properties and flammability. Exposure may occur at sites where 2-chlorotoluene is manufactured or used as a pesticide, solvent, or intermediate in the synthesis of dyes, pharmaceuticals, or synthetic rubber chemicals. This colorless liquid may exert its strong irritant properties upon dermal contact or inhalation. To assure protection against

2-chlorotoluene exposure a full-face mask self-contained breathing apparatus and protective clothing should be worn. The ACGIH recommends maintaining an 8-hr TLV of 50 ppm. While this substance must be moderately heated before ignition occurs, 2-chlorotoluene is nevertheless considered a combustion hazard. For fires involving 2-chlorotoluene, extinguish with "alcohol foam", CO2, dry chemical, or water in flooding quantities as fog (solid streams may be

inefective). Flooding quantities of water should be applied from as far a distance as possible, to

cool affected containers. This substance should be

stored away from heat or flames. Containers of 2-chlorotoluene may be shipped by air, rail, road, or water, and should be affixed with labels stating, "Flammable Liquid." Other DOT regulatory requirements should be consulted before transport. For small spills of 2-chlorotoluene, take up with sand or other noncombustible absorbent and place into containers for later disposal. For large spills, dike to prevent 2-chlorotoluene from entering water sources and sewers. Prior to implementing land disposal of waste residue (including waste sludge) consult with environmental regulatory agencies for guidance.

PEER REVIEWED*

FIRE POTENTIAL

SLIGHT, WHEN EXPOSED TO HEAT OR FLAME.

/4-Chlorotoluene/ [Sax, N.I. Dangerous Properties of Industrial Materials. 4th ed. New York: Van Nostrand Reinhold, 1975., p. 556] **PEER REVIEWED**

NFPA HAZARD CLASSIFICATION

Health: 2. 2= Materials hazardous to health, but areas may be entered freely with full-face mask

self-contained breathing apparatus which provides eye protection. /4-Chlorotoluene/ [National Fire Protection Association. Fire Protection Guide on Hazardous Materials. 9th ed. Boston, MA: National Fire Protection Association, 1986. 325M-27] **PEER REVIEWED**

NFPA HAZARD CLASSIFICATION

Flammability: 2. 2 = Material which must be moderately heated before ignition will occur.

Water spray may be used to extinguish the fire because the material can be cooled below its flash point. /4-Chlorotoluene/ [National Fire Protection Association. Fire Protection Guide on Hazardous Materials. 9th ed. Boston, MA: National Fire Protection Association, 1986. 325M-27] **PEER REVIEWED**

NFPA HAZARD CLASSIFICATION

Reactivity: 0. 0 = Materials which (in themselves) are normally stable even under fire exposure

conditions and which are not reactive with water. Normal fire fighting procedures may be used. /4-Chlorotoluene/ [National Fire Protection Association. Fire Protection Guide on Hazardous Materials. 9th ed. Boston, MA: National Fire Protection Association, 1986. 325M-27] **PEER REVIEWED**

SKIN, EYE AND RESPIRATORY ... strong irritant /4-Chlorotoluene/ [Sax, N.I. IRRITATIONS and R.J. Lewis, Sr. (eds.). Hawley's Condensed

Chemical Dictionary. 11th ed. New York: Van Nostrand Reinhold Co., 1987., p. 274] **PEER REVIEWED**

THE FOLLOWING OVERVIEW IS A SUMMARY. CONSULT THE COMPLETE POISINDEX (R) DATABASE FOR TREATMENT PURPOSES. COPYRIGHT 1974-YEAR MICROMEDEX, INC.

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EMERGENCY MEDICAL TREATMENT LIFE SUPPORT:

This overview assumes that basic life support measures have been instituted.

CLINICAL EFFECTS:

SUMMARY

- o SUMMARY: It is important to remember to treat the patient, not his poison. Symptomatic and supportive care is the mainstay of therapy (Saddique et al, 1986).
- o An approach to an unknown poison is to:
- 1. First assess the substance in question as well as the route of administration for potential toxicity (Nicholson, 1983).
- 2. Second, support vital functions and monitor cardiac status, vital signs, fluid intake and output, body temperature, and determine if a Swan-Ganz catheter is indicated to monitor pulmonary wedge pressure (Nicholson, 1983).
- 3. Third (oral exposures especially), prevent absorption by various combinations of emetics, lavage, cathartics, or adsorbents (Saddique et al, 1986).
- 4. Appropriate laboratory tests should be ordered (Nicholson, 1983).
- 5. Assess the patient's level of consciousness (Nicholson, 1983).
- o Symptoms seen due to unknown poisons may occur to any of the body systems, and a thorough diagnostic evaluation should be performed on any patient involved in exposure to an unknown agent.

LABORATORY:

o There are various laboratory tests and screens available for compounds and groups of compounds. In cases of unknown ingestion, it is important to consult a competent analytical chemist so that correct samples can be drawn to obtain the widest variety of compounds with the minimum number of samples. As part of the consult with the chemist, symptoms, and suspicions from the history should be discussed. In this matter the chemist can help pick appropriate screens and not waste time on poisons that do not fit the symptomatology. Blood, urine, and gastric

contents may be potential samples and should be saved until after the consult with the analytical chemist.

TREATMENT OVERVIEW:

SUMMARY

- o This management is intended for use in the absence of a specific treatment protocol for a product, drug or chemical. It should be used when an agent is not listed in the file and some guidelines may be needed for patient care. It may also be helpful when an experimental agent has been ingested and there is no data available on its toxicity.
- o Remember that up to 50% of all initial histories are incorrect and that history should be obtained from several individuals if possible. Important information to be obtained from products includes the type of packaging, the amount in the package, and the amount remaining after ingestion.
- o In first examining the patient remember to:
- 1. Assess life threatening potential.
- 2. Cardiopulmonary stabilization is mandatory.
- 3. If the patient is comatose or seizing, dextrose, naloxone, and oxygen should immediately be administered.
- 4. Appropriate laboratory samples should be taken.
- 5. Serial examinations should be performed to chart whether the patient is improving or deteriorating.

ORAL EXPOSURE

- o The goal is to remove, detoxify, or prevent absorption of ingested substances. Which of the following measures is appropriate will depend somewhat on the patients symptomatology and the possible ingestants involved.
- o EMESIS: May be indicated in recent substantial ingestion unless the patient is or could rapidly become obtunded, comatose or convulsing. Is most effective if initiated within 30 minutes. (Dose of Ipecac Syrup: ADULT: 30 mL; CHILD 1 to 12 years: 15 mL).
- o GASTRIC LAVAGE: May be indicated if performed soon after ingestion, or in patients who are comatose or at risk of convulsing. After control of any seizures present, perform gastric lavage. Protect airway by placement in Trendelenburg and left lateral decubitus position or by cuffed endotracheal intubation. Lavage return should approximate fluid given.
- o ACTIVATED CHARCOAL/CATHARTIC: Administer charcoal slurry, aqueous or mixed with saline cathartic or sorbitol. Usual charcoal dose: 30 to 100 g in adults and 15 to 30 g in children (1 to 2 g/kg in infants). Administer one dose of a cathartic, mixed with charcoal

or given separately. See Section 5.3.1. for doses.

- o WHOLE GUTLLAVAGE: Has been utilized as alternative methods for G.I. decontamination. The use of whole gut lavage in the management of poison patients is currently controversial. Potential hypertonic solutions for use include Colyte(R) and Golytely(R).
- o INTRAVENOUS-ENVENOMATION PROCEDURES: There is little that can be done to eliminate exposure to toxins administered intravenously or by envenomation.

 Procedures such as fasciectomy and fasciotomy are recommended when documented pressure myolysis is function-threatening.
- TREATMENT IN GENERAL
- 1. Establishment of respiration and the creation of an artificial airway is necessary.
- 2. Treat hypotension with fluids or plasma try to avoid vasopressors if possible.
- 3. HYPOTENSION: Administer IV fluids and place in Trendelenburg position. If unresponsive to these measures, administer dopamine (2 to 5 mcg/kg/min) or norepinephrine (0.1 to 0.2 mcg/kg/min) and titrate as needed to desired response.
- 4. Coma should be treated in an appropriate manner regardless of the suspected cause. Attention should be paid to respiration and circulation. The use of naloxone may be recommended if the coma is due to opioids or is of unknown origin. It does not cause respiratory paralysis.
- 5. Monitory cerebral intraventricular pressure and restrict fluids, or administer mannitol or furosemide if hypotension is not induced in cases of postanoxic cerebral edema/hyperthermia. Corticosteroids may be of some use. Enhanced elimination may be done by forced diuresis, alkaline forced diuresis, dialysis, or exchange transfusion.

INHALATION EXPOSURE

- o DECONTAMINATION: Move patient to fresh air. Monitor for respiratory distress; if cough or difficulty in breathing develops, evaluate for respiratory tract irritation, bronchitis, or pneumonitis. Administer 100% humidified supplemental oxygen with assisted ventilation as required.
- o Carefully observe patients with inhalation exposure for the development of any systemic signs or symptoms and administer symptomatic treatment as necessary.

EYE EXPOSURE

o DECONTAMINATION: Exposed eyes should be irrigated with copious amounts of tepid water for at least 15 minutes. If irritation, pain, swelling, lacrimation, or photophobia persist, the patient should probably be seen

in a health care facility.

DERMAL EXPOSURE

o DECONTAMINATION: Wash exposed area extremely thoroughly with soap and water. A physician may need to examine the area if irritation or pain persist.

RANGE OF TOXICITY:

o In many cases the amount of toxin ingested will be unknown, or the milligram/kilogram toxicity of the agent itself will be uncertain. As stated above, it is the patient, not the poison which should be treated in these cases, and until the toxic substance or the substances toxicity has been more accurately determined the amount ingested will have less relevance than the patients clinical condition.

REFERENCE: [Rumack BH & Spoerke DG: POISINDEX(R) Information System. Micromedex Inc., Denver, CO, 1990; CCIS CD-ROM Volume 65, edition exp September, 1990.] **PEER REVIEWED**

HUMAN TOXICITY EXCERPTS /Representative of chemical production plant

stated/... production people in plant ... who have handled material for years, have never encountered cases in skin irritation or other forms of poisoning due to contact with, or inhalation of the product. [American Conference of Governmental Industrial Hygienists. Documentation of the Threshold Limit Values and Biological Exposure Indices. 5th ed. Cincinnati, OH:, p. 137] **PEER REVIEWED**

HUMAN TOXICITY EXCERPTS VAPOR HARMFUL. [The Merck Index. 10th ed. Rahway, New Jersey: Merck Co., Inc., 1983., p. 306]

PEER REVIEWED

NON-HUMAN TOXICITY

The undiluted material has been admin orally to

EXCERPTS rats in doses ranging from 50-100 mg/kg. Moderate to marked weakness was noted and vasodilatation was produced at the higher dose levels. All rats

survived & were gaining wt 2 wk later. ...
[American Conference of Governmental Industrial

Hygienists. Documentation of the Threshold Limit Values and Biological Exposure Indices. 5th ed. Cincinnati, OH: , p. 137] **PEER REVIEWED**

NON-HUMAN TOXICITY Undiluted liquid was applied under an occlusive EXCERPTS dressing to two guinea pigs in doses of 1 cc and

10 cc/kg for a 24 hr period. There was moderately severe local irritation and evidence of skin absorption ... both animals had lost wt two weeks

after exposure. [American Conference of

Governmental Industrial Hygienists. Documentation

of the Threshold Limit Values and Biological

Exposure Indices. 5th ed. Cincinnati, OH: , p. 137| **PEER REVIEWED**

NON-HUMAN TOXICITY

One drop of undiluted material instilled in the

EXCERPTS

eye of a rabbit resulted in a delayed reaction which produced moderate erythema of the conjunctiva. After 24 hr the anterior portion of the cornea was opaque but had grossly returned to its normal appearance 14 days later. [American Conference of Governmental Industrial Hygienists. Documentation of the Threshold Limit Values and Biological Exposure Indices. 5th ed. Cincinnati,

OH: , p. 137] **PEER REVIEWED**

NON-HUMAN TOXICITY

Rats exposed for 6 hr to an atm of 21 mg/l or

EXCERPTS

about 4000 ppm lost coordination in 1.5 hr, prostration occurred in 1.75 hr, and tremors in 2 hours. Marked vasodilation also developed. All 3 animals survived, and 14 days later had gained wt averaging 33 grams each. Three rats were exposed to an atmospheric concn of 73 mg/l or 14,000 ppm. They suffered loss of coordination, vasodilatation, labored respiration, /CNS depression/, red tears, but all survived. Rats exposed to 900 mg/l (approximately 175,000 ppm). One animal died. There was severe prostration of the other two. They survived and were gaining wt 14 days later. [American Conference of Governmental Industrial Hygienists. Documentation of the Threshold Limit Values and Biological

Exposure Indices. 5th ed. Cincinnati, OH:, p.

137 **PEER REVIEWED**

NON-HUMAN TOXICITY
EXCERPTS no

Y In a study by /a chemical manufacturer/, the nominal chamber concentration was calculated to be

22.2 mg/l or about 4,400 ppm. Mice exhibited gasping, ataxia, and convulsions within 30 minutes after exposure; rats and guinea pigs showed gasping, hyperpnea, ataxia and convulsions in 45 minutes, & all animals were comatose in 60 minutes. All mice & rats succumbed as did 7 of the 10 guinea pigs. [American Conference of Governmental Industrial Hygienists. Documentation of the Threshold Limit Values and Biological Exposure Indices. 5th ed. Cincinnati, OH: , p. 137] **PEER REVIEWED**

ENVIRONMENTAL

o-Chlorotoluene may be released to the environment

FATE/EXPOSURE SUMMARY in emissions and effluents from sites of its manufacture or industrial use, from venting during storage and transport, and from disposal of industrial waste products which contain this compound (ie spent solvent). If released to soil, o-chlorotoluene is expected to have moderate to

low mobility and should volatilize fairly rapidly from soil surfaces. The significance of biodegradation in soil or water is not known although some data are available in water suggesting that the rate is slow. If released to water, volatilization (half-life in a model river 3.4 hours) and adsorption to suspended solids and sediments are expected to be important fate processes. This compound is not expected to undergo chemical hydrolysis, react with oxidants found in natural waters or bioaccumulate significantly in aquatic organisms. If released to the atmosphere, the dominant removal mechanism is expected to be reaction with photochemically generated hydroxyl radicals (half-life 8.4 days). The general population may be exposed to o-chlorotoluene by inhalation of contaminated air or ingestion of contaminated drinking water. (SRC) [CITATION] **PEER REVIEWED**

ENVIRONMENTAL FATE TERRESTRIAL FATE: If released to soil,

o-chlorotoluene is expected to have moderate to low mobility and should volatilize fairly rapidly from both wet and dry soil surfaces. Chemical hydrolysis would not be environmentally important. The significance of biodegradation is not known although some data are available in water, suggesting that the rate is slow. (SRC) [CITATION 1**PEER REVIEWED**

] **PEER REVIEWED**

ENVIRONMENTAL FATE AQUATIC FATE: If released to water, volatilization (half-life in a model river 3.4 hours) and adsorption to suspended solids and sediments are predicted to be the important fate processes. This compound is not expected to undergo chemical hydrolysis, react with oxidants found in natural waters or bioaccumulate significantly in aquatic ogansisms. Due to a lack of data, the significance of biodegradation is not known. (SRC) [CITATION]

PEER REVIEWED

ENVIRONMENTAL FATE

Based on a vapor pressure of 3.6 mm Hg at 25 deg

C(1), o-chlorotoluene is expected to exist almost
entirely in the vapor phase in the
atmosphere(2,SRC). The dominant removal mechanism
is expected to be reaction with photochemically
generated hydroxyl radicals (half-life 8.4 days).

A water solubility of 89 mg/l at 20 deg C suggests
that some o-chlorotoluene may be removed from the
atmosphere in precipitation(3,SRC); however, much
of this loss should be returned to the atmosphere
by volatilization(SRC). [(1) Riddick JA et al;
Organic Solvents: Physical Properties and Methods

of Purification 4th ed NY: Wiley-Interscience p. 483 (1986) (2) Eisenreich SJ et al; Environ Sci Tech 15: 30-8 (1981) (3) GEMS; Graphical Exposure Modeling System. PCCHEM. USEPA (1987)] **PEER REVIEWED**

BIODEGRADATION

Japanese MITI, initial concn 100 ppm, 14 days <30% BODT, activated sludge inoculum(1,2). A second order rate constant for the microbial degradation of o-chlorotoluene in natural water was experimentally determined to be 2.7X10-11 l/organism-hr(3). Microorganisms capable of degrading o-chlorotolune were isolated from soil samplesllected at a landfill site used for the disposal of chlorinated organic wastes(4). [(1) Kawasaki M; Ecotox Environ Safet 4: 444-54 (1980) (2) Sasaki S; pp. 283-98 in Aquatic Pollutants: Transformation and Biological Effects; Hutzinger O et al eds Oxford: Pergamon Press (1978) (3) Paris DF et al; Amer Chem Soc, Div Environ Chem Preprint 180th Natl Mtg 20: 55-6 (1980) (4) Vandenbergh PA et al; Appl Environ Microbio 42: 737-9 (1981)] **PEER REVIEWED**

ABIOTIC DEGRADATION o-Chlorotoluene is inert to chemical hydrolysis

under environmental conditions(1). Reaction of o-chlorotoluene with free- radical oxidants found in natural waters is not expected to be an environmentally important fate process(1,2). The half-life for o-chlorotoluene vapor reacting with photochemically generated hydroxyl radicals in the atmosphere has been estimated to be 8.4 days based on a reaction rate constant of 1.9X10-12 cu cm/molecule-sec at 25 deg C and an average hydroxyl radical concentration of 5.0X10+5 molecules/cu cm(3,SRC). [(1) Jaber HM et al; Data Acquisition for Environmental Trnasport and Fate Screening p. 249 USEPA-600/6-84/009 NTIS PB84-243906 (1984) (2) Howard, JA, Chenier JHB; J Am Chem Soc 95: 3054-9 (1973) (3) Atkinson R; Inter J Chem Kinetics 19: 799-828 (1987)] **PEER **REVIEWED****

BIOCONCENTRATION Based on a log Kow of 3.42, a bioconcentration

factor (BCF) of 234 was estimated for o-chlorotoluene(1,2,SRC). This BCF value and an estimated water solubility of 89 mg/l at 25 deg C both suggest that slight bioaccumulation in aquatic organisms may occur(SRC). [(1) Hansch C, Leo AJ; Medchem Project Issue No. 26 Claremont, CA: Pomona College (1985) (2) Lyman WJ et al; p. 5-5 in Handbook of Chemical Property Estimation Methods NY: McGraw-Hill (1982)] **PEER REVIEWED***

WATER CONCENTRATIONS DRINKING WATER: Drinking water concentrates: Oct 1978, Cincinnati, OH - 1.6-2.0 ng/l; Feb 1976, Miami, FL - 1.2 ng/l; Nov 1976, Seattle, WA - 0.1-0.2 ng/l(1). [(1) Lucas SV; GC/MS Analysis of Organics in Drinking Water Concentrates and Advanced Waste Treatment Concentrates Vol. 2 p. 57 USEPA-600/1-84-020B NTIS PB85-128239 (1984)]

PEER REVIEWED

WATER CONCENTRATIONS GROUNDWATER: As of June 30, 1984 - Wisconsin, 1174 community wells, 0.09% pos, 617 private wells, 0% pos, detection limit 1.0-5.0 ug/l(1). During 1981-1982, 945 wells scattered throughout the USA, 0.1% pos, concn detected 2.4 ug/l, detection limit 0.2-0.5 ug/l(2). [(1) Krill RM, Sonzogni WC; J Am Water Works Assoc 78: 70-5 (1986) (2) Westrick JJ et al; J Am Water Works Assoc 76: 52-9 (1984)]

PEER REVIEWED

WATER CONCENTRATIONS SURFACE WATER: Delaware River, winter - 3 ug/l, summer - not detected(1). Identified in the Niagara River(2). 1976, River Maas at Eysden (The Netherlands), median concn- not detected, concn range not detected-0.1 ug/l(1). 1976, River Maas at Keizersveer (The Netherlands), median concn- not detected, concn range not detected to 0.1 ug/l(detection limit not specified)(1). 1977-1979

Detected in the river Rhine(3). Detected in Rhine water at a concentration > 1 ug/l, but was not identified in related tap-water (water treated by

water at a concentration > 1 ug/l, but was not identified in related tap-water (water treated by bank filtration)(4). [(1) Verschueren K; Handbook of Environmental Data on Organic Chemicals 2nd ed NY: Van Nostrand Reinhold pp. 386-7 (1983) (2) Great Lakes Water Quality Board; p. 59 in An Inventory of Chemical Substances Identified in the Great Lakes Ecosystem Vol. 1- Summary Ontario,

Canada: Great Lakes Quality Board (1983) (3) Malle KG; Z Wasser-Abwasser-Forsch 17: 75-81 (1984) (4)

Piet GJ, Morra CF; pp. 31-42 in Artificial

Groundwater Recharge (Water Resource Engineering Series); Huisman L, Olsthorn TN eds MA: Pitman Pub

(1983)] **PEER REVIEWED**
PROBABLE ROUTES OF HUMAN The general population may be exposed to

EXPOSURE

o-chlorotoluene by inhalation of contaminated air or ingestion of contaminated drinking water(1,2,3,SRC). Workers involved in the manufacture, use, packaging, or transport of this compound may be exposed by inhalation and/or

dermal contact(4,SRC). [(1) Harkov R et al; Sci Tot Environ 38: 259-74 (1984) (2) Pellizzari ED et

al; Formulation of Preliminary Assessment of Halogenated Organic Compounds in Man and

Environmental Media pp. 55,57,72 USEPA-560/13-79-006 (1979) (3) Lucas SV; GC/MS Analysis of Organics in Drinking Water Concentrates and Advanced Waste Treatment Concentrates Vol 2 p. 57 USEPA-600/1-84-020B NTIS PB85-128239 (1984) (4) ACGIH; Documentation of the Threshold Limit Value and Biological Exposure Indices 5th ed Cincinnati, OH: ACGIH pp. 95-6 (1986)] **PEER REVIEWED**

SOIL ADSORPTION/MOBILITY Measured soil adsorption coefficients (Koc) for o-chlorotoluene ranged between 170-880, average value was 370(1). These Koc values suggest that o-chlorotoluene would have moderate to low mobility in soil and that some adsorption to suspended solids and sediments in water would take place(2,SRC). [(1) Banerjee P et al; Chemosphere 14: 1057-67 (1985) (2) Swann RL et al; Res Rev 85: 17-28 (1983)] **PEER REVIEWED**

VOLATILIZATION FROM Experimental marine mesocosm under simulated WATER/SOIL winter conditions (3-7 deg C), initial concn 2.3

ug/l, using monitoring data the half-life of o-chlorotoluene was estimated to be 12 days(1). Volatilization appeared to be the dominant removal mechanism. Volatilization in a bay or ocean should be significantly faster (perhaps up to an order of magnitude) since turbulence in the mesocosm was substantially less than is found in bays or open oceans(1). Henry's law constant for o-chlorotoluene has been estimated to be 6.7X10-3 atm m/mole at 25 deg C using an estimated vapor pressure of 3.6 mm Hg at 25 deg C and a water solubility of 89 mg/l at 25 deg C(2,3,SRC). This value of Henry's law constant suggests that volatilization would probably be significant from all bodies of water and moist soil surfaces(4). Based on this value the volatilization half-life from a model river 1 m deep, flowing 1 m/sec with a wind speed of 3 m/sec was estimated to be 3.4 hours(4, SRC). Due to its relatively high vapor pressure o-chlorotoluene is expected to volatilize fairly rapidly from dry soil surfaces(2,SRC). [(1) Wakeham SG et al; Environ Sci Tech 17: 611-7 (1983) (2) Riddick JA et al; Organic Solvents: Physical Properties and Methods of Purification 4th ed NY: Wiley-Interscience p. 485 (1986) (3) Yalkowsky SH et al; Arizona Data Base 2nd ed (1987) (4) Lyman WJ et al; pp. 15-12 to 15-32 in Handbook of Chemical Property Estimation Methods NY: McGraw-Hill (1982)] **PEER REVIEWED**

THRESHOLD LIMIT VALUES Time-Weighted Avg (TWA) 50 ppm, 259 mg/cu m; Short

Term Exposure Limit (STEL) 75 ppm, 388 mg/cu m [American Conference of Governmental Industrial Hygienists. Threshold Limit Values and Biological Exposure Indices for 1989-1990. Cincinnati, OH: American, p. 17] **QC REVIEWED**

THRESHOLD LIMIT VALUES Notice of Intended Change (first notice appeared in 1988-89 edition): The ACGIH has listed chemicals for which it has been proposed to delete their "adopted" Short Term Exposure Limits. The proposed deletion should be consided trial proposal that will remain in the listing for a period of at least two years. If, after two years no evidence comes to light that questions the appropriateness of the deletion, it will be reconsidered to remove the values from the "adopted" list. [American Conference of Governmental Industrial Hygienists. Threshold Limit Values and Biological Exposure Indices for 1989-1990. Cincinnati, OH: American, p. 46] **QC **REVIEWED****

Dichlorobenzene

DICHLOROBENZENE

Summary

Dichlorobenzene (DCB) is probably persistent in the natural environment. In rats, chronic oral exposure to dichlorobenzene caused liver and kidney damage and changes in the hematopoietic system. In humans, DCB is a skin and eye irritant; inhalation exposure causes nausea and irritates the membranes. The EPA Ambient Water Quality Criterion for the protection of human health is $400~\mu g/liter$.

CAS Number: 1,2-Dichlorobenzene (1,2-DCB) 95-50-1

1,3-Dichlorobenzene (1,3-DCB) 541-73-1

1,4-Dichlorobenzene (1,4-DCB) 106-46-7

Chemical Formula: C₆H₄Cl₂

IUPAC Name: Dichlorobenzene

Important Synonyms and Trade Names: Dichlorobenzene, DCB

Chemical and Physical Properties

Molecular Weight: 147.01

Boiling Point: 1,2-DCB: 180.5°C

1,3-DCB and 1,4-DCB: 173°C

Melting Point: 1,2-DCB:-17.0°C

1,3-DCB:-24°C 1,4-DCB:-53°C

Specific Gravity: 1.3 at 20°C

Solubility in Water: 1,2-DCB: 145 mg/liter at 25°C

1,3-DCB: 123 mg/liter at 25°C 1,4-DCB: 80 mg/liter at 25°C

Solubility in Organics: Soluble in alcohol, ether, acetone,

benzene, carbon tetrachloride, and

ligroin

Log Octanol/Water Partition Coefficient: 3.38

Vapor Pressure: 1 mm Hg at 20°C

Vapor Density: 5.05

Dichlorobenzene Page 1 October 1985 Henry's Law Constant: $1.99 \times 10^{-3} \text{ atm m}^3/\text{mole}$

Flash Point: 71°C

Transport and Fate

Relatively little information concerning the environmental fate of dichlorobenzene (DCB) is available. DCB is expected to volatilize at a relatively rapid rate, and atmospheric transport can occur. It has an estimated half-life for removal from agitated surface water of 9 hours or less. Dichlorobenzenes are reported to be reactive toward hydroxyl radicals in air with a half-life of about 3 days, but indirect evidence suggests that DCB does not hydrolyze at a significant rate under normal environmental conditions. The high log octanol/water partition coefficient for DCB suggests that adsorption to organic matter in aquatic systems and soil is probably an important environmental fate process. Indirect evidence suggests that bioaccumulation may also be an important fate process. DCB appears to be resistant to biodegradation. However, it may be broken down to some degree by pollutant-acclimatized microorganisms. Sorption, bioaccumulation, and volatilization with subsequent atmospheric oxidation are likely to be competing processes, with the dominant fate being determined by local environmental conditions. volatilization doesn't occur, dichlorobenzene is probably rather . persistent.

Health Effects

It is generally thought that the available data are inadequate for assessing the carcinogenic potential of DCB in animals and humans. One case study suggests an association between exposure to dichlorobenzene and several cases of leukemia. DCB is reported to be nonmutagenic in <u>Salmonella typhimurium</u> tester strains. Mutagenic and clastogenic activity reportedly occurs in some plant test systems. No data are available for evaluating the teratogenic or reproductive effects in animals or humans.

Symptoms of acute inhalation intoxication in humans include headache, nausea, and throat irritation. DCB is also a skin and eye irritant.

A variety of other symptoms, including weakness, fatigue, and anemia, have been observed after chronic dermal and inhalation exposure to dichlorobenzene.

Inhalation of DCB causes eye and upper respiratory tract irritation, central nervous system depression, and liver and kidney damage in experimental animals. An LC_{20} of approximately

Dichlorobenzene Page 2 October 1985 4,900 mg/m³/7 hours is reported for the rat. No toxic effects were observed after daily 7-hour inhalation exposures of up to 560 mg/m³ for as much as 7 months in several species of experimental animals. Hepatic porphyria is reported to occur in rats after daily tracheal intubation of 455 mg/m³ for up to 15 days. Oral exposure results in stimulation of liver microsomal enzyme systems and cumulative toxicity. The oral LD₅₀ for the rat is 500 mg/kg. Chronic oral exposure to 188 mg/kg/day causes liver and kidney damage in rats. Exposure to 0.01-0.1 mg/kg/day produces changes in the hematopoietic system, increased prothrombin time, and altered conditioned reflexes and enzyme activities in chronically exposed rats. In general, toxicity increases in the order 1,4-DCB, 1,3-DCB, 1,2-DCB.

Toxicity to Wildlife and Domestic Animals

The 48-hour and 96-hour LC₅₀ values for Daphnia and bluegills, respectively, tested under static conditions, were 2,440 and 5,590 µg/liter (1,2-DCB); 28,100 and 5,020 µg/liter (1,3-DCB); and 11,000 and 4,280 µg/liter (1,4-DCB). Two flow through 96-hour LC₅₀ tests using fathead minnows and rainbow trout gave values of about 3,000 µg/liter. A freshwater chronic value of 2,000 µg/liter is reported for the fathead minnow. Acute values for three saltwater species ranged from 1,970 µg/liter for the mysid shrimp to 9,660 µg/liter for the sheepshead minnow. No saltwater chronic values are available. A whole body bioconcentration factor of about 80 is reported for the bluegill.

The 96-hour median effect levels for chlorophyll \underline{a} and cell number are 179,000 and 149,000 $\mu g/liter$, respectively, in the freshwater alga Selenastrum capricornutum. In the saltwater alga Skeletonema costatum the corresponding values are 44,200 and 44,100 $\mu g/liter$, respectively.

Regulations and Standards

Ambient Water Quality Criteria (USEPA):

Aquatic Life

The available data are not adequate for establishing criteria.

Human Health

Criterion: 400 µg/liter

OSHA Standard: 300 mg/m³ Ceiling Level

ACGIH Threshold Limit Value: 300 mg/m³ Ceiling Level

Dichlorobenzene Page 3 October 1985

REFERENCES

- AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH).
 1980. Documentation of the Threshold Limit Values. 4th
 ed. Cincinnati, Ohio. 488 pages
- INTERNATIONAL AGENCY FOR RESEARCH ON CANCER (IARC). 1982.
 IARC Monographs on the Evaluation of the Carcinogenic
 Risk of Chemicals to Humans. Vol. 29: Some Industrial
 Chemicals and Dyestuffs. World Health Organization, Lyon
 France. Pp. 213-238
- NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH).
 1984. Registry of Toxic Effects of Chemical Substances.
 Data Base. Washington, D.C. July 1984
- SAX, N.I. 1975. Dangerous Properties of Industrial Materials. 4th ed. Van Nostrand Reinhold Co. New York. 1,258 pages
- U.S. ENVIRONMENTAL PROTECTION AGENCY (USEPA). 1979. Water-Related Environmental Fate of 129 Priority Pollutants. Washington, D.C. December 1979. EPA 440/4-79-029
- U.S. ENVIRONMENTAL PROTECTION AGENCY (USEPA). 1980. Ambient Water Quality Criteria for Dichlorobenzenes. Washington, D.C. October 1980. EPA 440/5-80-039
- WEAST, R.E., ed. 1981. Handbook of Chemistry and Physics. 62nd ed. CRC Press, Cleveland, Ohio. 2332 pages

Ethylbenzene

ETHYLBENZENE

Summary

There is some evidence suggesting that ethylbenzene causes adverse reproductive effects in animals. Oral and inhalation exposure caused minor liver and kidney changes in rats. Ethylbenzene is a skin and eye irritant. The EPA Ambient Water Quality Criterion for the protection of human health is 1.4 mg/liter.

CAS Number: 100-41-4

Chemical Formula: C6H5C2H5

IUPAC Name: Ethylbenzene

Important Synonyms and Trade Names: Phenylethane, EB, ethylbenzol

Chemical and Physical Properties

Molecular Weight: 106.2

Boiling Point: 136.2°C

Melting Point: -95°C

Specific Gravity: 0.867 at 20°C (liquid)

Solubility in Water: 161 mg/liter at 25°C

Solubility in Organics: Freely soluble in organic solvents

Log Octanol/Water Partition Coefficient: 3.15

Vapor Pressure: 7 mm Hg at 20°C

Vapor Density: 3.66

Henry's Law Constant: 6.44 atm. m³/mole

Flash Point: 17.2°C

Transport and Fate

Only limited data are available on the transport and fate of ethylbenzene. Volatilization is probably the major route of elimination from surface water. Subsequent atmospheric reactions, especially photooxidation, are responsible for its

Ethylbenzene Page 1 October 1985 fate. However, its high log octanol/water partition coefficient suggests that a significant amount of ethylbenzene may be adsorbed by organic material in the sediment. Some soil bacteria are capable of using ethylbenzene as a source of carbon. However, the relative importance of this potential route of ethylbenzene elimination has not been determined.

Health Effects

Ethylbenzene has been selected by the National Toxicology Program to be tested for possible carcinogenicity, although negative results were obtained in mutagenicity assays in Salmonella typhimurium and Saccharomyces cerevisiae. There is recent animal evidence that ethylbenzene causes adverse reproductive effects. Ethylbenzene is a skin irritant, and its vapor is irritating to the eyes at a concentration of 200 ppm (870 mg/m³) and above. When experimental animals were exposed to ethylbenzene by inhalation, 7 hours/day for 6 months, adverse effects were produced at concentrations of 600 ppm (2,610 mg/m³) and above, but not at 400 ppm (1,740 mg/m³). At 600 ppm rats and guinea pigs showed slight changes in liver and kidney weights, monkeys had slight changes in liver weight, and monkeys and rabbits experienced histopathologic changes in the testes. Similar effects on the liver and kidney were observed in rats fed ethylbenzene at 408 and 680 mg/kg/day for 6 months.

Toxicity to Wildlife and Domestic Animals

Ethylbenzene was acutely toxic to freshwater species at levels greater than 32 mg/liter. No chronic toxicity was reported, but the highest test dose (440 μ g/liter) was only one-hundredth of the 96-hour LC₅₀ for the particular species being tested. No studies on the bloaccumulation of ethylbenzene were reported in the information reviewed, but a bioconcentration factor of 95 was calculated using the log octanol/water partition coefficient. No information on the toxicity of ethylbenzene to domestic animals and terrestrial wildlife was found in the sources reviewed.

Regulations and Standards

Ambient Water Quality Criteria (USEPA):

Aquatic Life

The available data are not adequate for establishing final criteria. However, EPA did report the lowest values known to have toxic effects in aquatic organisms.

Ethylbenzene Page 2 October 1985

Freshwater

Acute toxicity: 32,000 µg/liter Chronic toxicity: No available data

Saltwater

Acute toxicity: 430 µg/liter Chronic toxicity: No available data

Human Health

Criterion: 1.4 mg/liter

OSHA Standard (skin): 435 mg/m3 TWA

ACGIH Threshold Limit Values: 435 mg/m³ TWA 545 mg/m³ STEL

REFERENCES

- AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH).
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Ethylbenzene Page 3 October 1985

Hexachlorobutadiene

HEXACHLOROBUTADIENE

Summary

Hexachlorobutadiene caused an increased incidence of kidney tumors in rats and was found to be mutagenic using the Ames assay. There is equivocal evidence that hexachlorobutadiene increases neonatal mortality. Chronic exposure to low levels of hexachlorobutadiene caused renal toxicity in rats and other studies have shown that exposure can affect the central nervous system and liver. Hexachlorobutadiene is also quite toxic to aquatic organisms. The EPA Ambient Water Quality Criterion for the protection of human health corresponding to an excess cancer risk of 10 is 0.45 µg/liter.

CAS Number: 87-68-3

Chemical Formula: Cl₂C:CClCCl:CCl₂

IUPAC Name: Hexachloro-1,3-butadiene

Important Synonyms and Trade Names: Dolen, GP-40-66:120, HCBD,

perchlorobutadiene, C46

Chemical and Physical Properties

Molecular Weight: 260.74

Boiling Point: 210 to 220°C

Melting Point: -19 to -22°C

Specific Gravity: 1.675 at 15.5°C

Solubility in Water: 2 mg/liter at 20°C

Solubility in Organics: Compatible with numerous resins; soluble

in alcohol and ether

Log Octanol/Water Partition Coefficient: 4.8

Vapor Pressure: 0.15 mm Hg at 20°C

Transport and Fate

Hexachlorobutadiene (HCBD) is probably rather persistent in the environment. Volatilization and adsorption to organic particulates are apparently important transport processes for HCBD. In soil and sediments, HCBD is bound to organic material.

Hexachlorobutadiene Page 1 October 1985 This process acts as a sink for HCBD in the environment. There was no information on the ultimate fate of HCBD in nature in the sources searched.

Health Effects

The International Agency for Research on Cancer (IARC 1979) notes that there is limited evidence that hexachlorobutadiene is a carcinogen. Their conclusion is based on one oral feeding study in rats in which the incidence of kidney tumors increased in the animals of both sexes given the highest doses (Kociba et al. 1977). The results of a spot test of HCBD using the Ames assay were positive. The data on the reproductive toxicity of HCBD are equivocal. One study indicates that neonatal mortality rose following a single, subcutaneous injection of 20 mg/kg body weight to the dam just prior to mating. Another, more recent experiment exposed male and female rats to doses of 0.2, 2, and 20 mg/kg/day for 90 days prior to mating and 15 days during gestation; no toxic effects were noted in the offspring. However, male and female rats given 2 or 20 mg/kg/day of HCBD showed signs of renal toxicity. The results of a 2year feeding study in rats confirmed that renal tubular hyperplasia was caused by doses larger than 2 mg/kg/day. Other studies have indicated that HCBD also affects the central nervous system and the liver (Harleman and Seinen 1979). HCBD is a cumulative toxin and is therefore more toxic after chronic exposures. The oral LD₅₀ for adult rats is 250 mg/kg, and the LD₅₀ for neonatal rats is one-quarter that for the adult animals:

Toxicity to Wildlife and Domestic Animals

Hexachlorobutadiene is very toxic to aquatic organisms, with 96-hour LC₅₀ values for goldfish, rainbow trout, fathead minnow, and bluegill ranging from 90 to 330 µg/liter. Its chronic toxicity, as measured in an embryo-larval test in fathead minnows, is 9.3 µg/liter. Invertebrates and saltwater fish were affected at similar levels.

The ingestion of up to 30 ppm of HCBD in their diets (approximately 5-6 mg/kg) had no effect on Japanese quail.

No studies on the toxicity on HCBD to domestic animals were discussed in the literature reviewed.

Regulations and Standards

Ambient Water Quality Criteria (USEPA):

Hexachlorobutadiene Page 2 October 1985 Aquatic Life
The available data are not adequate for establishing criteria.

Human Health
Estimates of the carcinogenic risks associated with lifetime exposure to various concentrations of HCBD in water are:

Risk	<u>Concentration</u>
10 ⁻⁵	4.5 µg/liter
10 ⁻⁶	0.45 µg/liter
10 ⁻⁷	0.045 µg/liter

CAG Unit Risk (USEPA): 7.75×10^{-2} (mg/kg/day)⁻¹

ACGIH Threshold Limit Value: Suspected carcinogen 0.24 mg/m3 TWA

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Naphthalene

NAPHTHALENE

Summary

Naphthalene retarded cranial ossification and heart development in the offspring of exposed pregnant rats. Inhalation exposure caused nausea, headache, and optic and kidney damage in humans and experimental animals. Oral administration produced cataracts in rabbits and induced changes in motor activity in rats and mice. Exposure to high doses of naphthalene cause severe hemolytic effects.

CAS Number: 91-20-3

Chemical Formula: C₁₀H₈

IUPAC Name: Naphthalene

Important Synonyms and Trade Names: Naphthene, tar camphor,

moth balls

Chemical and Physical Properties

Molecular Weight: 128.16

Boiling Point: 217.9°C

Melting Point: 80.2°C

Specific Gravity: 1.152 at 20°C

Solubility in Water: 34.4 mg/liter at 25°C

Solubility in Organics: Soluble in alcohol, ether, acetone,

and benzene

Log Octanol/Water Partition Coefficient: 3.37

Vapor Pressure: 0.087 mm Hg at 25°C

Vapor Density: 4.42

Transport and Fate

Environmental transport and fate is largely inferred from data for polycyclic aromatic hydrocarbons (PAHs) in general, because specific information for naphthalene is lacking. Rapid, direct photolysis of naphthalene to quinones may be an important

Naphthalene Page 1 October 1985 process in surface waters. Oxidation is probably too slow to be a significant environmental process. However, data for some PAHs suggest that oxidation by chlorine or ozone may be a significant fate process when these oxidants are available insufficient quantity. Volatilization may play a role in transport depending on mixing rates in both the water column and air column. For naphthalene, adsorption is the most important aquatic transport process. Consideration of its log octanol/water partition coefficient and of the behavior of other PAHs indicate that naphthalene can be strongly adsorbed onto suspended and sedimentary particulate matter, especially particulates high in organic content. Dominance of volatilization or absorption as a transport process is directly related to environmental conditions. It is likely that this compound can be readily transported as adsorbed matter or suspended particulates in air or water.

Based on information concerning related compounds, it is likely that bioaccumulation of naphthalene is short term, especially for vertebrates. Although this compound is rapidly accumulated, it also is rapidly metabolized and excreted, and consequently bioaccumulation is not considered an important fate process. Naphthalene can be metabolized by multicellular organisms and degraded by microbes. Degradation by mammals is likely to be incomplete, with paten compound and the metabolites being excreted by the urinary system. Biodegradation by microorganisms is probably the ultimate fate process for naphthalene. Biodegradation generally appears to be more efficient in soil than in aquatic systems. However, experimental data indicate that biodegradation may be more important in those aquatic systems which are chronically affected by PAH contamination.

Atmospheric transport of PAHs can occur, and these materials can be returned to aquatic and terrestrial systems by wet and dry deposition. Some PAHs may enter surface and groundwaters by leaching from polluted soils.

Health Effects

There are no epidemiological or case studies available suggesting that naphthalene is carcinogenic in humans. This compound is not generally considered to be carcinogenic in experimental animals. However, there is equivocal evidence suggesting weak carcinogenic activity in rats after subcutaneous injection. Naphthalene is reported to produce DNA damage in mice after intraperitoneal injection. Retarded cranial ossification and heart development are reported among offspring of rats injected intraperitoneally with naphthalene on days 1 to 15 of gestation.

Little information concerning acute and chronic toxic effects is available. Inhalation exposure to naphthalene may cause headache, loss of appetite, nausea, and kidney damage in humans and experimental animals. Acute hemolytic effects are reportedly caused by ingestion or inhalation of relatively large quantities of naphthalene. Optical neuritis, injuries to the cornea, and opacities of the lens also may result after inhalation exposure or ingestion. Naphthalene is a mild eye irritant in rabbits, and cataracts can be induced after oral administration. Application to the skin produces erythema and slight edema in rabbits. Somnolence and changes in motor activity are observed after ingestion of naphthalene by rats and mice. Oral LD₅₀ values of 1,250 mg/kg and 580 mg/kg are reported for the rat and the mouse, respectively.

Toxicity to Wildlife and Domestic Animals

The median effect concentrations for freshwater invertebrate species and three fish species are all reported to be greater than 2,300 µg/liter. Acute values reported for saltwater polychaete, oyster, and shrimp species are all greater than 2,350 µg/liter. A chronic value of 620 µg/liter and an acute-chronic ratio of 11 is reported for the fathead minnow, a freshwater species. No chronic values are available for saltwater species. Freshwater algae appear to be less sensitive to the effects of naphthalene than animal species. No information concerning saltwater plant species is available. The weighted average bioconcentration factor for the edible portion of all freshwater and estuarine aquatic organisms consumed by Americans is 10.5.

Regulations and Standards

Ambient Water Quality Criteria (USEPA):

The available data are not adequate for establishing criteria.

OSHA Standard: 50 mg/m³ TWA

ACGIH Threshold Limit Values: 50 mg/m³ TWA 75 mg/m³ STEL

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N-Propylbenzene

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- HSDB
HSN - 5353
DATE - 891121
UPDT - Complete Update on 11/21/89, 11 fields added/edited/deleted.
UPDT - Complete Update on 10/03/86
RLEN - 8923
NAME - N-PROPYLBENZENE
RN - 103-65-1
SY - 1-PHENYLPROPANE **PEER REVIEWED**
    - 1-PROPYLBENZENE **PEER REVIEWED**
- BENZENE, PROPYL **PEER REVIEWED**
    - PROPYLBENZENE **PEER REVIEWED**
    - C9-H12 **PEER REVIEWED**
WLN -
3R
**PEER REVIEWED**
RTEC - NIOSH/DA8750000
MMFG - ... BY ACTION OF DIETHYL SULFATE ON BENZYLMAGNESIUM CHLORIDE: GILMAN,
MEYERS, ORG SYN 4: 59 (1925); GILMAN, CATLIN, ORG SYN, COLL VOL I (2ND ED, 1941) P 471. [MERCK INDEX 9TH ED 1976, p. 1016] **PEER REVIEWED**
MMFG - ...IS PRODUCED IN PETROLEUM REFINING & AS BYPRODUCT OF CUMENE MFR.
[NRC. DRINKING WATER & HEALTH 1977, p. 761] **PEER REVIEWED**
MMFG - PROBABLY BY ALKYLATION OF BENZENE WITH N-PROPYL CHLORIDE IN THE
      PRESENCE OF ALUMINUM CHLORIDE; FRACTIONAL DISTILLATION OF PETROLEUM
      REFORMATE [SRI ] **PEER REVIEWED**
MFS - ETHYL CORP, CHEMS GROUP, ORANGEBURG, SC 29115 [SRI] **PEER REVIEWED**
MFS - FRANK ENTERPRISES, INC, COLUMBUS, OH 43219 [SRI] **PEER REVIEWED**
MFS - Niagara Technology Inc, 21 Isabelle St, Buffalo, NY 14207,
(716)876-3341 [CHEMICALWEEK BUYERS' GUIDE '86 p.489] **QC REVIEWED**
USE - IN TEXTILE DYEING & PRINTING; AS SOLVENT FOR CELLULOSE ACETATE [MERCK INDEX 9TH ED 1976, p. 1016] **PEER REVIEWED**
USE - IN MFR OF METHYLSTYRENE [NRC. DRINKING WATER & HEALTH 1977, p. 761]
      **PEER REVIEWED**
USE - SOLVENT, EG, FOR CELLULOSE ACETATE & IN TEXTILE DYEING [SRI ] **PEER REVIEWED**
CPAT - ND [SRI ] **PEER REVIEWED**
PROD - (1977) AT LEAST 4.54X10+10 GRAMS [SRI ] **PEER REVIEWED**
COFO - COLÓRLESS LIQUID [PATTY. INDUS HYG & TOX 3RD ED VOL2A,2B,2C 1981-82,
     p. 3305] **PEER REVIEWED**
      - 159.2 DEG C AT 760 MM HG [MERCK INDEX 9TH ED 1976 , p. 1016] **PEER
      REVIEWED**
MP --99.2 DEG C [MERCK INDEX 9TH ED 1976, p. 1016] **PEER REVIEWED**
MW - 120.19 [MERCK INDEX 9TH ED 1976, p. 1016] **PEER REVIEWED**
DEN -0.8620 AT 20 DEG C/4 DEG C [WEAST. HDBK CHEM & PHYS 60TH ED 1979 C-170]
      **PEER REVIEWED**
SOL - VERY SLIGHTLY SOL IN WATER (0.06 G/L); SOL IN ALCOHOL, ETHER [MERCK
INDEX 9TH ED 1976, p. 1016] **PEER REVIEWED**
SOL - SOL IN ALL PROPORTIONS IN ACETONE, BENZENE, PETROLEUM ETHER, CARBON
      TETRACHLORIDE [WEAST. HDBK CHEM & PHYS 60TH ED 1979 C-170] **PEER
      REVIEWED**
SPEC - INDEX OF REFRACTION: 1.4920 AT 20 DEG C/D; SADTLER REFERECNE NUMBER
      5654 (IR, PRISM); MAX ABSORPTION (ISOOCTANE): 249 NM (LOG E= 2.07),
      261.5 NM (LOG E= 2.31), 264.5 NM (LOG E= 2.19), 268 NM (LOG E= 2.20)
      [WEAST. HDBK CHEM & PHYS 60TH ED 1979 C-170] **PEER REVIEWED**
VAPD - 4.14 (AIR = 1) [PATTY. INDUS HYG & TOX 3RD ED VOL2A,2B,2C 1981-82, p.
      3257 **PEER RÉVIEWED**
VAP - 1 MM HG AT 6.3 DEG C [WEAST. HDBK CHEM & PHYS 60TH ED 1979 D-212]
      **PEER REVIEWED*
OCPP - CONVERSION FACTOR (WT/VOL): 4.92 MG/CU M IS EQUIVALENT TO 1 PPM [PATTY.
      INDUS HYG & TOX 3RD ED VOL2A,2B,2C 1981-82, p. 3257] **PEER REVIEWED**
OCPP - [Sato A, Nakajima T; Scand J Work Environ Health 13: 81-93 (1987)]
      Partition coefficients at 37 deg C for N-propylbenzene into blood = 47.0; into oil = 9,780. **QC REVIEWED**
FLMT - 0.8-6% [PATTY. INDUS HYG & TOX 3RD ED VOL2A,2B,2C 1981-82, p. 3257]
       **PEER REVIEWED**
FLPT - 30 DEG C (86 DEG F) [PATTY. INDUS HYG & TOX 3RD ED VOL2A,2B,2C 1981-82, p. 3257] **PEER REVIEWED**
DOT - Fire or Explosion: Flammable/combustible material; may be ignited by
      heat, sparks or flames. Vapors may travel to a source of ignition and
      flash back. Container may explode in heat of fire. Vapor explosion
      hazard indoors, outdoors or in sewers. Runoff to sewer may create fire
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or explosion hazard. [DOT. EMERGENCY RESPONSE GUIDEBOOK 1987 G-26] **QC

DOT - Health Hazards: May be poisonous if inhaled or absorbed through skin. Vapors may cause dizziness or suffocation. Contact may irritate or burn skin and eyes. Fire may produce irritating or poisonous gases. Runoff from fire control or dilution water may cause pollution. [DOT. EMERGENCY RESPONSE GUIDEBOOK 1987 G-26] **QC REVIEWED**

DOT - Emergency Action: Keep unnecessary people away, isolate hazard area and deny entry. Stay upwind; keep out of low areas. Self-contained breathing apparatus (SCBA) and structural firefighter's protective clothing will provide limited protection. Isolate for 1/2 mile in all directions if tank car or truck is involved in fire. CALL CHEMTREC AT 1-800-424-9300 FOR EMERGENCY ASSISTANCE. If water pollution occurs, notify the appropriate authorities. [DOT. EMERGENCY RESPONSE GUIDEBOOK 1987 G-26] **QC REVIEWED**

DOT - Fire: Small Fires: Dry chemical, CO2, Halon, water spray or alcohol foam. Large Fires: Water spray, fog or alcohol foam is recommended. Move container from fire area if you can do it without risk. Cool containers that are exposed to flames with water from the side until well after fire is out. Stay away from ends of tanks. For massive fire in cargo area, use unmanned hose holder or monitor nozzles; if this is impossible, withdraw from area and let fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tank due to fire. [DOT. EMERGENCY RESPONSE GUIDEBOOK 1987 G-26] **QC

DOT - Spill or Leak: Shut off ignition sources; no flares, smoking or flames in hazard area. Stop leak if you can do it without risk. Water spray may reduce vapor, but it may not prevent ignition in closed spaces. Small Spills: Take up with sand or other noncombustible absorbent material and place into containers for later disposal. Large Spills Dike far ahead of liquid spill for later disposal. [DOT. EMERGENCY RESPONSE GUIDÉBOOK 1987 G-26] **QC REVIEWED**

DOT - First Aid: Move victim to fresh air and call emergency medical care; if not breathing, give artificial respiration; if breathing is difficult, give oxygen. In case of contact with material, immediately flush eyes with running water for at least 15 minutes. Wash skin with soap and water. Remove and isolate contaminated clothing and shoes at the site.

[DOT. EMERGENCY RESPONSE GUIDEBOOK 1987 G-26] **QC REVIEWED**
HTOX - ...IRRITATING TO MUCOUS MEMBRANES, EYES, NOSE, THROAT & SKIN.
SYSTEMICALLY, IT CAUSES DEPRESSION OF CNS, HEADACHE, ANOREXIA, MUSCULAR
WEAKNESS, INCOORDINATION, NAUSEA, VERTIGO, MENTAL CONFUSION, & UNCONSCIOUSNESS. [NRC. DRINKING WATER & HEALTH 1977, p. 761] **PEER

NTOX - IN 6-MO SUBCHRONIC ORAL STUDY, GROUPS OF 15 RABBITS WERE FED...0..25 & 2.5 MG/KG/DAY. ... HEMOSIDERIN WAS DEPOSITED IN SPLEENS OF HIGH-DOSAGE ANIMALS, INDICATING RED-CELL DESTRUCTION. ... INDIVIDUAL ANIMALS EXHIBITED MILD PROTEIN DYSTROPHY OF LIVER & KIDNEYS. [NRC. DRINKING

WATER & HEALTH 1977, p. 763] **PEER REVIEWED**
NTOX - IT PRODUCED 2 DEATHS OF 10 RATS AT 5.0 MG/KG FROM ORAL ADMIN. IN MOUSE IT PRODUCES A LOSS OF RIGHTING RESPONSE AT 10 TO 15 MG/L (2000-3000 PPM), LOSS OF REFLEXES AT 15 MG/L (3000 PPM) & DEATH AT 20 MG/L (4100 PPM) FROM INHALATION. /FROM TABLE/ [PATTY. INDUS HYG & TOX 3RD ED VOL2A,2B,2C 1981-82, p. 3308] **PEER REVIEWED**
- ...PROBABLY READILY ABSORBED FROM GI TRACT & LUNGS & EXCRETED MAINLY IN

URINE OF HUMANS. [NRC. DRINKING WATER & HEALTH 1977, p. 761] **PEER

METB - IN RATS, THERE APPEARS TO BE A DUAL METABOLIC PATHWAY: SIDE-CHAIN MEIB - IN RAIS, THERE APPEARS TO BE A DUAL METABOLIC PATHWAY: SIDE-CHAIN OXIDATION & RING HYDROXYLATION, WITH FORMER PREFERRED. [NRC. DRINKING WATER & HEALTH 1977, p. 761] **PEER REVIEWED**

NATS - Naturally occurring in petroleum [VERSCHUEREN. HDBK ENVIRON DATA ORG CHEM 1983 p.1026] **QC REVIEWED**

ARTS - Present in gasoline at 0.61 wt % [VERSCHUEREN. HDBK ENVIRON DATA ORG CHEM 1983 p.1026] **QC REVIEWED**

EXP - <Date entered: 11/02/89 > The effect of hydrophobic organic chemicals on the rate of feeding by mussels (Mytilus edulis) was investigated. The

the rate of feeding by mussels (Mytilus edulis) was investigated. The effect was expressed as the toxicant concn in water required to reduce feeding rate by 50% (WECSO). A quantitative structure-activity relationship (QSAR) was derived in which WEC50 was negatively correlated with log 10 octanol-water partition coefficient (log Kow) and positively correlated with aqueous solubility, indicating that hydrophobicity has a major influence on toxicity. QSARs calculated between bioconcentration factor, and log Kow and aqueous solubility showed that hydrophobicity influences toxicity largely through its

effect on bioconcentration. This observation was confirmed by expressing toxicity as the toxicant conon in mussel tissue required to reduce feeding rate by 50% (TECS0). For the compounds tested which have log Kow values < 4.6, TECS0 was relatively constant, irrespective of molecular structure. Compounds with log Kow values > 5 could be accumulated to much greater conon before feeding rate was affected, indicating that there is a molecular wt cut-off in the toxicological response. The log10 Kow for n-propylbenzene was 3.69, the mean bioconcentration factor was 38.0, the WECS0 was 0.86 mg/l (0.69-1.07 mg/l) and the TECS0 was 27.0 mg/kg (22.7-32.1 mg/kg). [Donkin P et al; Aquat Toxicol 14 (3): 277-94 (1989)] **QC REVIEWED**

EXP - <Date entered: 11/02/89> A modified variant of the purge-and-trap gas

chromatographic analysis of volatile organic carbon compounds in water was designed. Samples collected in glass 1 l bottles are purged at 60 C for 1 h{r in an ultrapure helium gas stream using an open loop arrangement. Volatile eluates are trapped onto selective adsorbents packed inside stainless steel tubes connected in series. After stripping at a flow rate of 100 mg/min for 60 min, the adsorbent tubes are disconnected, fitted with analytical desorption caps and sequentially desorbed for 10 min on a thermal desorber. The desorbed organics are trapped at 30 C on a packed cold trap prior to flash volatilization of the volatiles across a fused silica transfer line onto a capillary column. The method separated over 200 organic compounds within 40 min using flame ionization and ion trap detection and is capable of quantitation down to 5 ng/l per component. The recoveries of n-propylbenzene from water at 30 and 60 C were 84 and 99%, respectively. Improvement was made of compound recovery by substituting a second Tenax-TA tube with Chromosorb 106 and a third Tenax-TA tube with Spherocarb. Percentage recoveries of n-propylbenzene with the two series of tubes (all Tenax-TA or 3 different kinds) were 92.7, 6.9, and 0.4%, and 91.5, 8.5%, and none for tubes 1, 2, and 3, respectively. [Bianchi A et al; J Chromatogr 467 (1): 111-28 (1989)] **QC REVIEWED**

Toluene

TOLUENE

Summary

Toluene has been shown to be embryotoxic in experimental animals, and the incidence of cleft palate was increased in the offspring of dosed mice. Chronic inhalation exposure to high levels of toluene caused cerebellar degeneration and an irreversible encephalopathy in animals. In humans, acute exposure depressed the central nervous system and caused narcosis. The EPA Ambient Water Quality Criterion for the protection of human health is 14.3 mg/liter.

CAS Number: 108-88-3

Chemical Formula: C₆H₅CH₃

IUPAC Name: Methylbenzene

Important Synonyms and Trade Names: Toluol, phenylmethane

Chemical and Physical Properties

Molecular Weight: 92.13

Boiling Point: 110.6°C

Melting Point: -95°C

Specific Gravity: 0.8669 at 20°C

Solubility in Water: 534.8 mg/liter

Solubility in Organics: Soluble in acetone, ligroin, and carbon

disulfide; miscible with alcohol, ether, benzene, chloroform, glacial acetic acid, and other organic solvents

Log Octanol/Water Partition Coefficient: 2.69

Vapor Pressure: 28.7 mm Hg at 25°C

Vapor Density: 3.14

Flash Point: 4.4°C

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Transport and Fate

Volatilization appears to be the major route of removal of toluene from aquatic environments, and atmospheric reactions of toluene probably subordinate all other fate processes. Photooxidation is the primary atmospheric fate process for toluene, and benzaldehyde is reported to be the principal organic product. Subsequent precipitation or dry deposition can deposit toluene and its oxidation products into aquatic and terrestrial systems. Direct photolytic cleavage of toluene is energetically improbable in the troposphere, and oxidation and hydrolysis are probably not important as aquatic fates.

The log octanol/water partition coefficient of toluene indicates that sorption processes may be significant. However, no specific environmental sorption studies are available and the extent to which adsorption by sedimentary and suspended organic material may interfere with volatilization is unknown. Bioaccumulation is probably not an important environmental fate process. Although toluene is known to be degraded by microorganisms, and can be detoxified and excreted by mammals, the available data do not allow estimation of the relative importance of biodegradation/biotransformation processes. Almost all toluene discharged to the environment by industry is in the form of atmospheric emissions.

Health Effects

There is no conclusive evidence that toluene is carcinogenic or mutagenic in animals or humans. The National Toxicological Program is currently conducting an inhalation carcinogenicity bioassay in rats and mice.

Oral administration of toluene at doses as low as 260 mg/kg produced a significant increase in embryonic lethality in mice. Decreased fetal weight was observed at doses as low as 434 mg/kg, and an increased incidence of cleft palate was seen at doses as low as 867 mg/kg. However, other researchers have reported that toluene is embryotoxic but not teratogenic in laboratory animals. There are no accounts of a teratogenic effect in humans being linked to toluene exposure.

Acute exposure to toluene at concentrations of 375-1,500 mg/m³ produces central nervous system depression and narcosis in humans. However, even exposures to quantities sufficient to produce unconsciousness fail to produce residual organ damage. The rat oral LD $_{30}$ value and inhalation LC $_{LO}$ value are 5,000 mg/kg and 15,000 mg/m³, respectively. Chronic inhalation exposure to toluene at relatively high concentrations produces cerebellar degeneration and an irreversible encephalopathy in mammals.

Toluene Page 2 October 1985 Toluene, in sufficient amounts, appears to have the potential to significantly alter the metabolism and resulting bioactivity of certain chemicals. For example, coadministration of toluene along with benzene or styrene has been shown to suppress metabolism of the benzene or styrene in rats. The estimated weighted average bioconcentration factor for toluene and the edible portion of all freshwater and estuarine aquatic organisms consumed by Americans is calculated to be 10.7.

Toxicity to Wildlife and Domestic Animals

Of five freshwater species acutely tested with toluene, the cladoceran Daphnia magna was most resistant. The EC₅₀ and LC₅₀ values for all species range from 12,700 to 313,000 µg/liter. No chronic tests are available for freshwater species. The two freshwater algal species tested are relatively insensitive to toluene with EC₅₀ values of 245,000 µg/liter or greater being reported. For saltwater species, EC₅₀ and LC₅₀ values range from 3,700 µg/liter for the bay shrimp to 1,050 mg/liter for the Pacific oyster. The chronic value in an embryo-larval test for the sheepshead minnow is reported to be between 3,200 and 7,700 µg/liter and the acute-chronic ratio is between 55 and 97. In several saltwater algal species and kelp, effects occur at toluene concentrations from 8,000 to greater than 433,000 µg/liter.

Regulations and Standards

Ambient Water Quality Criteria (USEPA):

Aquatic Life

The available data are not adequate for establishing criteria. However, EPA did report the lowest concentrations of toluene known to be toxic in aquatic organisms.

Freshwater

Acute toxicity: 17,500 µg/liter Chronic toxicity: No available data

Saltwater

Acute toxicity: 6,300 µg/liter Chronic toxicity: 5,000 µg/liter

Human Health

Criterion: 14.3 mg/liter

Toluene Page 3 October 1985 NIOSH Recommended Standards: 375 mg/m³ TWA 560 mg/m³ STEL

OSHA Standards: 750 mg/m³ TWA 1,120 mg/m³ Ceiling Level

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1,3,5-Trimethylbenzene

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- HSDB
HSN - 92
DATE - 890929
UPDT - Complete Update on 09/29/89, 3 fields added/edited/deleted. UPDT - Complete Update on 04/13/89, 1 field added/edited/deleted.
UPDT - Complete Update on 10/14/86
RLEN - 21320
NAME - MESITYLENE
 RN - 108-67-8
      - 1,3,5-TRIMETHYLBENZENE **PEER REVIEWED**
      - FLEET-X **PEER REVIEWED**
      - SYM-TRIMETHYLBENZENE **PEER REVIEWED**
       - TMB **PEER REVIEWED**
       - TRIMETHYLBENZOL **PEER REVIEWED**
 MF - C9-H12 **PEER REVIEWED**
 WLN -
1R CE
 **PEER REVIEWED**
RTEC - NIOSH/OX6825000
MMFG - EXTRACTED FROM COAL TAR [SRI ] **PEER REVIEWED**

MMFG - BY DEHYDRATING ACETONE WITH SULFURIC ACID. [MERCK INDEX 9TH ED 1976,
p. 768] **PEER REVIEWED**

MMFG - BY FRACTIONATION OF COAL TAR & PETROLEUM DISTILLATES. [BROWNING. TOX &
       METAB INDUS SOLV 1965, p. 111] **PEER REVIEWED**

- Mesitylene contains 1 wt% pseudocumeme and 0.5 wt% other aromatic compounds [KIRK-OTHMER ENCYC CHEM TECH 3RD ED 1978-PRESENT V18 p.883]

**QC REVIEWED**
FORM - Mesitylene is 98.5 wt% pure [KIRK-OTHMER ENCYC CHEM TECH 3RD ED 1978-PRESENT V18 p.883] **QC REVIEWED**

MFS - SUN CO, INC, SUN OIL CO OF PENNSYLVANIA, SUBSID, SUNTIDE REFINING CO, SUBSID, CORPUS CHRISTI, TEX 78403 [SRI ] **PEER REVIEWED**

MFS - Koch Chemical Co, a Div of Koch Refining Co, Specialties Group, Suntide Rd, Corpus Christi, TX 78403, (512)241-4811 [CHEMICALWEEK BUYERS' GUIDE '86 p.409] **QC REVIEWED**

OMIN - /MESITYLENE (1,3,5)/ IS ONE OF THREE ISOMERS OF TRIMETHYLBENZENE.
...EXPOSURE TO ANY OF ISOMERS ALONE IS POSSIBLE...MORE PROBABLE THAT EXPOSURE WOULD BE TO AN ISOMETRIC MIXTURE WHICH IS IN ITSELF PORTION OF COAL TAR OR PETROLEUM DISTILLATE, [ACGIH, TLVS 3RD ED & SUPPL, 1971-1979
         COAL TAR OR PETROLEUM DISTILLATE. [ACGIH. TLVS 3RD ED & SUPPL 1971-1979
        , p. 269] **PEER REVIEWED**
 USE - DYESTUFF INTERMEDIATE, SOLVENT, PAINT THINNER [ENCYC OCCUPAT HEALTH &
SAFETY 1971, p. 692] **PEER REVIEWED**
USE - CHEM INT FOR ANTHRAQUINONE VAT DYES & FOR UV OXIDATION STABILIZERS FOR PLASTICS [SRI] **PEER REVIEWED**
 CPAT - ND [SRI ] **PEER REVIEWED**
 PROD - (1972) PROBABLY GREATER THAN 4.54X10+5 GRAMS [SRI ] **PEER REVIEWED**
PROD - (1975) PROBABLY GREATER THAN 454X10+5 GRAMS [SRI ] **PEER REVIEWED**
PROD - (1986) ND [CITATION ] **QC REVIEWED**
IMPT - (1972) ND [SRI ] **PEER REVIEWED**
IMPT - (1975) ND [SRI ] **PEER REVIEWED**
IMPT - (1984) 1.58x10+8 g [BUREAU OF THE CENSUS. U.S. IMPORTS FOR CONSUMPTION AND GENERAL IMPORTS 1984 p.1-327] **QC REVIEWED**

EXPT - (1972) ND [SRI] **PEER REVIEWED**

EXPT - (1975) ND [SRI] **PEER REVIEWED**
 EXPT - (1986) ND [CITATION ] **QC REVIEWED**
 COFO - LIQUID [MERCK INDEX 9TH ED 1976, p. 768] **PEER REVIEWED**
COFO - CLEAR, COLORLESS [BROWNING. TOX & METAB INDUS SOLV 1965, p. 111]
         **PEER REVIEWED**
 ODOR - PECULIAR ODOR [MERCK INDEX 9TH ED 1976, p. 768] **PEER REVIEWED** BP - 164.7 DEG C @ 760 MM HG [MERCK INDEX 9TH ED 1976, p. 768] **PEER
         REVIEWED**
MP - 44.8 DEG C [MERCK INDEX 9TH] i ED 1976 , p. 768] **PEER REVIEWED**
MW - 120.19 [MERCK INDEX 9TH ED 1976 , p. 768] **PEER REVIEWED**
DEN - 0.8637 @ 20 DEG C/4 DEG C [MERCK INDEX 9TH ED 1976 , p. 768] **PEER
         REVIEWED**
         - PRACTICALLY INSOL IN WATER; MISCIBLE WITH ALCOHOL, ETHER, BENZENE
        [MERCK INDEX 9TH ED 1976, p. 768] **PEER REVIEWED**
- MISCIBLE WITH ACETONE, CARBON TETRACHLORIDE, PETROLEUM ETHER [WEAST.
         HDBK CHEM & PHYS 60TH ED 1979 C-172] **PEER REVIEWED**
 SPEC - INDEX OF REFRACTION: 1.49541 @ 18 DEG C/D [MERCK INDEX 9TH ED 1976, p.
         768] **PEER REVIEWED**
 SPEC - MAX ABSORPTION (ALCOHOL): 258 NM (LOG E= 2.2); 263 NM (LOG E= 2.2); 267
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NM (LOG E= 2.2); 273 NM (LOG E= 2.3) [WEAST. HDBK CHEM & PHYS 60TH ED

1979 C-172] **PEER REVIEWED**

VAPD - 1.006 @ 20 DEG C (AIR = 1) [BROWNING. TOX & METAB INDUS SOLV 1965, p. 111] **PEER REVIEWED**

VAP - 1.86 MM HG @ 20 DEG C [BROWNING. TOX & METAB INDUS SOLV 1965, p. 111] **PEER REVIEWED**

OCPP - CONVERSION FACTORS: 1 PPM = 4.92 MG/CU M; 1 MG/L= 203.5 PPM [BROWNING.

TOX & METAB INDUS SOLV 1965, p. 111] **PEER REVIEWED**

FPOT - MODERATE, VIA HEAT, FLAMES, OXIDIZERS [SAX. DANGER PROPS INDUS MATER

5TH ED 1979, p. 799] **PEER REVIEWED**

FLPT - 122 DEG F [BROWNING. TOX & METAB INDUS SOLV 1965, p. 111] **PEER

REVIEWED**

AUTO - 1022 DEG F [SAX. DANGER PROPS INDUS MATER 5TH ED 1979, p. 799] **PEER REVIEWED**

FIRP - WATER SPRAY, FOG, FOAM, CO2 (SAX. DANGER PROPS INDUS MATER 5TH ED 1979 , p. 799] **PEER REVIEWED**

EXPL - ... RISK OF... EXPLOSION REQUIRES THAT CONCN OF VAPOR IN ATMOSPHERE IS KEPT BELOW 35-50 PPM BY MEANS OF EFFECTIVE VENTILATION OR PREFERABLY, LOCAL APPLIED EXHAUST VENTILATION. /TRIMETHYLBENZENES/ [ENCYC OCCUPAT

HEALTH & SAFETY 1971, p. 692] **PEER REVIEWED**

REAC - REACTS VIOLENTLY WITH NITRIC ACID. [SAX. DANGER PROPS INDUS MATER 5TH ED 1979, p. 799] **PEER REVIEWED**

OPRM - WHEN, FOR PURPOSE OF WELDING OR CUTTING, HEAT HAS TO BE APPLIED TO

VESSEL THAT HAS CONTAINED TRIMETHYLBENZENE VESSEL SHOULD FIRST BE DRAINED, PURGED & TESTED AS FOR ENTRY, /TRIMETHYLBENZENES/ [ENCYC OCCUPAT HEALTH & SAFETY 1971, p. 692] **PEER REVIEWED**
SHIP - CONTAINERS: DRUMS, TANK TRUCKS [HAWLEY. CONDENSED CHEM DICTNRY 9TH ED

1977, p. 551] **PEER REVIEWED**
STRG - STORAGE TANKS SHOULD BE MOUNDED TO CONFINE ESCAPING LIQUID & ESCAPE FROM PROCESS VESSELS SHOULD BE CONTROLLED IN SIMILAR MANNER BY SILLS @ DOORWAYS, DESIGN OF FLOORS, ETC. /TRIMETHYLBENZENES/ [ENCYC OCCUPAT HEALTH & SAFETY 1971, p. 692] **PEER REVIEWED**

DOT - Health Hazards: Poisonous; may be fatal if inhaled, swallowed or

absorbed through skin. Contact may cause burns to skin and eyes. Runoff from fire control or dilution water may cause pollution. [DOT. EMERGENCY RESPONSE GUIDEBOOK 1987 G-28] **QC REVIEWED**

DOT - Fire or Explosion: Flammable/combustible material; may be ignited by heat, sparks or flames. Vapors may travel to a source of ignition and flash back. Container may explode in heat of fire. Vapor explosion and poison hazard indoors, outdoors or in sewers. Runoff to sewer may create fire or explosion hazard. [DOT. EMERGENCY RESPONSE GUIDEBOOK 1987 G-28] **QC REVIEWED**

DOT - Emergency Action: Keep unnecessary people away, isolate hazard area and deny entry. Stay upwind; keep out of low areas. Self-contained breathing apparatus and chemical protective clothing which is specifically recommended by the shipper or producer may be worn but they do not provide thermal protection unless it is stated by the clothing manufacturer. Structural firefighter's protective clothing is not effective with these materials. Isolate for 1/2 mile in all directions if tank car or truck is involved in fire. CALL CHEMTREC AT 1-800-424-9300 FOR EMERGENCY ASSISTANCE. If water pollution occurs, notify the appropriate authorities. [DOT. EMERGENCY RESPONSE GUIDEBOOK 1987 G-28] **QC REVIEWED**

DOT - Fire: Small Fires: Dry chemical, CO2, Halon, water spray or standard foam. Large Fires: Water spray, fog or standard foam is recommended. Move container from fire area if you can do it without risk. Dike fire control water for later disposal; do not scatter the material. Cool containers that are exposed to flames with water from the side until well after fire is out. Stay away from ends of tanks. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tank due to fire. [DOT. EMERGENCY RESPONSE GUIDEBOOK

1987 G-28] **QC REVIEWED**

DOT - Spill or Leak: Shut off ignition sources; no flares, smoking or flames in hazard area. Do not touch spilled material; stop leak if you can do it without risk. Water spray may reduce vapor, but it may not prevent ignition in closed spaces. Small Spills: Take up with sand or other disposal. Large Spills: Dike far ahead of liquid spill for later disposal. [DOT. EMERGENCY RESPONSE GUIDEBOOK 1987 G-28] **QC REVIEWED**

DOT - First Aid: Move victim to fresh air and call emergency medical care; if not breathing, give artificial respiration; if breathing is difficult,

give oxygen. Remove and isolate contaminated clothing and shoes at the site. In case of contact with material, immediately flush skin or eyes

with running water for at least 15 minutes. Keep victim quiet and maintain normal body temperature. Effects may be delayed; keep victim under observation. [DOT. EMERGENCY RESPONSE GUIDEBOOK 1987 G-28] **QC REVIEWED**

THIS OVERVIEW IS A SUMMARY. CONSULT THE COMPLETE POISINDEX (R) DATABASE FOR TREATMENT PURPOSES. COPYRIGHT 1974-YEAR MICROMEDEX, INC. ALL RIGHTS RESERVED. DUPLICATION PROHIBITED.

EMT - LIFE SUPPORT

This overview assumes that basic life support measures have been instituted.

CLINICAL EFFECTS

SUMMARY

o Mesitylene is an irritant of eyes, skin, and the respiratory tract. Chronic exposure may cause an asthmatic-like bronchitis. Aspiration may cause chemical pneumonitis with pulmonary edema and hemorrhage. Mesitylene causes CNS depression and narcosis. Thrombocytopenia, mild anemia, and coagulation disorders may also occur. Elevations in liver function tests have been noted.

LABORATORY

- A number of chemicals produce abnormalities of the hematopoietic system, liver, and kidneys. Monitoring complete blood count, urinálysis, and liver and kidney function tests is suggested for patients with significant exposure.
- o If respiratory tract irritation is present, monitor arterial blood gases, chest x-ray, and pulmonary function tests

TREATMENT OVERVIEW

SUMMARY

o Move victims of inhalation exposure from the toxic environment and administer 100 percent humidified supplemental oxygen with assisted ventilation as required. Exposed eyes and skin should be thoroughly flushed with water. Inducing EMESIS should MOST LIKELY BE AVOIDED. Cautious gastric lavage and administration of activated charcoal might be beneficial. If CNS depression is present, airway compromise and inadequate ventilation may occur.

ORAL EXPOSURE

- o GASTRIC LAVAGE: May be indicated if performed soon after ingestion, or in comatose or convulsing patients. Protect airway by placement in Trendelenburg and left lateral decubitus position or by cuffed endotracheal intubation. Lavage return should approximate fluid given.
- Ensure airway patency and adequacy of ventilation and oxygenation. Endotracheal intubation, supplemental oxygenation, and assisted ventilation could be required.
- Carefully monitor complete blood count and clotting parameters. If severe anemia or bleeding disorders occur, transfusion therapy with whole blood or packed red blood cells and fresh frozen plasma could be required. Vitamin K therapy could be required for correction of clotting abnormalities.
- Observe patients with ingestion carefully for the possible development of esophageal or gastrointestinal tract irritation or burns. If signs or symptoms of esophageal irritation or burns are present, esophagoscopy may be considered to determine the extent of injury.

INHALATION EXPOSURE

DECONTAMINATION: Move patient to fresh air. Monitor for respiratory distress; if cough or difficulty in

breathing develops, evaluate for respiratory tract irritation, bronchitis, or pneumonitis. Administer 100% humidified supplemental oxygen with assisted ventilation

If bronchospasm and wheezing are present, treatment with

inhaled sympathomimetic agents may be required.
PULMONARY EDEMA: Maintain ventilation and oxygenation with close arterial blood gas monitoring. If PO2 remains less than 50 mmHg, PEEP or CPAP may be necessary. Avoid net positive fluid balance; monitor through central line or Swan Ganz catheter.

EYE EXPOSURE

o DECONTAMINATION: Exposed eyes should be irrigated with copious amounts of tepid water for at least 15 minutes. If irritation, pain, swelling, lacrimation, or photophobia persist, the patient should probably be seen in a health care facility.

DERMAL EXPOSURE

- o DECONTAMINATION: Wash exposed area extremely thoroughly with soap and water. A physician may need to examine the area if irritation or pain persist.
- Treat dermal irritation or burns with standard topical therapy. Patients developing hypersensitivity dermal reactions may require treatment with systemic or topical corticosteroids or antihistamines.

RANGE OF TOXICITY

4 of 10 rats died following inhalation of 2400 ppm for 24 hours. An oral dose of 5 mL/kg caused death in 1 of 10 rats. The TCLo for humans is 10 ppm with somnolence and respiratory tract irritation noted.

[Rumack BH & Spoerke DG: POISINDEX(R) Information REFERENCE Systems Micromedex Inc., Denver, CO, 1989; CCIS CD-ROM
Volume 62, edition exp February 28, 1990. }
HTOX - ...THE LIQUID SOLVENT IS PRIMARY SKIN IRRITANT, BUT SYSTEMIC

- INTOXICATION DUE TO ABSORPTION THROUGH THE SKIN IS NOT PROBABLE DEPOSITION OF LIQUID INTO THE LUNGS CAUSES CHEMICAL PNEUMONITIS AT SITE OF CONTACT. HIGH CONCENTRATIONS OF VAPORS (5000 TO 9000 PPM) CAUSES CNS DEPRESSION. [ACGIH. TLVS 3RD ED & SUPPL 1971-1979, p. 269] **PEER REVIEWED**
- HTOX WORKERS EXPOSED FOR YEARS TO SOLVENT "FLEET-X-OV-99" (30% MESITYLENE & 50% PSEUDOCUMENE)/...HAD SYMPTOMS OF NERVOUSNESS, TENSION, ANXIETY AND ASTHMATIC BRONCHITIS. ...PERIPHERAL BLOOD SHOWED TENDENCY TO HYPOCHROMIC ANEMIA AND DEVIATION FROM NORMAL COAGULATION...VAPOR CONCN WAS 10-60 PPM... [ACGIH. TLVS 3RD ED & SUPPL 1971-1979, p. 269] **PEER REVIEWED**

NTOX - IN ANIMALS SUBJECTED TO ACUTE LETHAL INTOXICATION, DEATH WAS PRECEDED BY CNS DEPRESSION AND RESPIRATORY FAILURE. [ENCYC OCCUPAT HEALTH & SAFETY 1971, p. 692] **PEER REVIEWED**

NTOX - ...RATS...INHALATION...AUTOPSY SHOWED HYPEREMIA OF LUNGS WITH THICKENING OF ALVEOLAR WALLS AND SOME FATTY CHANGES IN THE LIVER.

IHICKENING OF ALVEOLAR WALLS AND SOME FATTY CHANGES IN THE LIVER.

[BROWNING. TOX & METAB INDUS SOLV 1965, p. 114] **PEER REVIEWED**

NTOX - DURING A SINGLE CONTINUOUS 24-HOUR EXPOSURE AT 2400 PPM MESITYLENE, 4
OUT OF 16 RATS DIED OF RESPIRATORY FAILURE... [ACGIH. TLVS 3RD ED &
SUPPL 1971-1979, p. 269] **PEER REVIEWED**

NTOX - ...EXPOSED RATS AT 1700 PPM OF AN ISOMERIC MIXTURE FOR 10-21 DAYS...NO
FATALITIES OR OTHER ADVERSE TOXICOLOGICAL EFFECTS. EXPOSURE FOR 4 MONTHS TO SAME CONCENTRATION CAUSED DIMINISHED WEIGHT GAIN AND INCREASING LYMPHOPENIA AND NEUTROPHILIA. MARKED CNS DEPRESSION WAS ALSO OBSERVED. /ISOMERIC MIXTURE/ [ACGIH. TLVS 3RD ED & SUPPL 1971-1979, p. 269] **PEER REVIEWED**

ADE - ABSORPTION TAKES PLACE MOST READILY BY INHALATION OF THE VAPOR, BUT THE LIQUID CAN BE ABSORBED FROM THE GASTRO-INTESTINAL TRACT, AND PROBABLY,

THOUGH SLOWLY, BY THE INTACT SKIN. [BROWNING. TOX & METAB INDUS SOLV 1965, p. 112] **PEER REVIEWED**

ADE - ...ONLY A SMALL PORTION IS EXCRETED UNCHANGED BY THE LUNGS, THE GREATER PART IS OXIDIZED TO WATER-SOLUBLE METABOLITES, WHICH ARE EXCRETED BY THE URINE, PARTLY FREE, PARTLY CONJUGATED WITH GLYCINE AND MESITYLENIC

ACID [BROWNING. TOX & METAB INDUS SOLV 1965, p. 112] **PEER REVIEWED**
ADE - ...INCR IN URINARY PHENOLS, BOTH FREE & BOUND, IN RATS SUBJECTED TO INHALATION OF 200, 580 & 1700 PPM OF 'FLEET-X-DV-99'. ...SINGLE SC

INJECTION OF MESITYLENE (5 ML/KG BODY WT) INCR URINARY EXCRETION OF ORG SULFATES. /ISOMERIC MIXT OF 30% MESITYLENE & 50% PSEUDOCUMENE USED/ [BROWNING. TOX & METAB INDUS SOLV 1965, p. 112] **PEER REVIEWED** METB - ...ONLY A SMALL PORTION IS EXCRETED UNCHANGED BY THE LUNGS, THE GREATER

PART IS OXIDIZED TO WATER-SOLUBLE METABOLITES, WHICH ARE EXCRETED BY THE URINE, PARTLY FREE, PARTLY CONJUGATED WITH GLYCINE AND MESITYLENIC ACID [BROWNING. TOX & METAB INDUS SOLV 1965, p. 112] **PEER REVIEWED**
METB - MESITYLINE YIELDS 2,4,6-TRIMETHYLPHENOL IN RAT. BAKKE, OM & SCHELINE,

RR, TOXICOL APPL PHARMAC, 16, 691 (1970). /FROM TABLE/ [GOODWIN. HDBK INTERMED METAB AROMAT COMPD 1976 M-5] **PEER REVIEWED**
METB - ONE METABOLITE OF MESITYLENE IS 3,5-DIMETHYLBENZOIC ACID. [LAHAM S,

MATUTINA EO; MICRODETERMINATION OF MESITYLENIC ACID IN HUMAN URINE; ARCH TOXIKOL 30 (3) 199-205 (1973)] **PEER REVIEWED**

METB - APPROX 78% OF ORAL DOSE OF MESITYLENE WAS EXCRETED AS

3,5-DIMETHYLHIPPURIC ACID; ADDITIONAL 7.6 & 8.2% WERE EXCRETED AS

GLUCURONIC & SULFURIC ACID CONJUGATES. [MIKULSKI PI, WIGLUSZ R; THE COMPARATIVE METABOLISM OF MESITYLENE, PSEUDOCUMENE, & HEMIMELLITENE IN RATS; TOXICOL APPL PHARMACOL 31 (1) 21-31 (1975)] **PEER REVIEWED**
INTC - EFFECT OF PHENOBARBITAL ADMIN ON METABOLISM IS DUE TO INCR IN RATE OF

AROMATIC HYDROXLATION RATHER THAN IN RATE OF FORMATION OF CORRESPONDING CARBOXYLIC ACID. [MIKULSKI PI, WIGLUSZ R; THE COMPARATIVE METABOLISM OF MESITYLENE, PSEUDOCUMENE, & HEMIMELLITENE IN RATS; TOXICOL APPL PHARMACOL 31 (1) 21-31 (1975)] **PEER REVIEWED**

INTC - Groups of 5 female SPF Sprague-Dawley rats (200 to 220 g) were exposed via inhalation for 2 hr to 120, 180, 400, or 720 ppm mesitylene,

without or in combination with 1000 or 4000 ppm ethyl acetate. Immediately after exposure, blood samples were collected. Co-exposure with ethyl acetate lowered blood conen of inhaled mesitylene, but the effect was not statistically significant. For example, at 400 ppm mesitylene, control blood concn was (75.8 + or - 2.1) x 10-6 mol/l vs
68.8 + or - 7.8) x 10-6 mol/l at 4000 ppm ethyl acetate. [Freundt KJ et
al; Bull Environ Contam Toxicol 42 (4): 495-8 (1989)] **QC REVIEWED**
NATS - OCCURS IN COAL TAR & IN PETROLEUM CRUDES. [MERCK INDEX 9TH ED 1976, p.

768] **PEER REVIEWED**

ARTS - A component of high octane gasoline at 1.32 wt% [VERSCHUEREN. HDBK ENVIRON DATA ORG CHEM 1983 p.812] **QC REVIEWED**
WATC - TRIMETHYLBENZENE: 6.1 UG/L IS HIGHEST CONCN IN FINISHED WATER. /FROM

TABLE; TRIMETHYBENZENE/ [NRC. DRINKING WATER & HEALTH 1977, p. 799] **PEER REVIEWED**

- 25 PPM (APPROX 120 MG/CU M) [ACGIH. TLVS 3RD ED & SUPPL 1971-1979 , p. 269] **PEER REVIEWED**

CLAB - THE EXTRACT OF METABOLITE 3,5-DIMETHYLBENZOIC ACID, IS DETERMINED BY MEANS OF THIN LAYER CHROMATOGRAPHY, UV LIGHT, & FINALLY SPECTROPHOTOMETER. METHOD IS SPECIFIC FOR 3,5-DIMETHYLBENZOIC ACID. ILAHAM S, MATUTINA EO; MICRODETERMINATION OF MESITYLENIC ACID IN HUMAN

URINE; ARCH TOXIKOL 30 (3) 199-205 (1973)] **PEER REVIEWED**
EXP - < Date entered: 09/11/89 > Groups of 5 female SPF Sprague-Dawley rats (200 to 220 g) were exposed via inhalation for 2 hr to 120, 180, 400 or 720 ppm mesitylene, without or in combination with 1000 or 4000 ppm ethyl acetate. Immediately after exposure, blood samples were collected. Co-exposure with ethyl acetate lowered blood concn of inhaled mesitylene, but the effect was not statistically significant. For example, at 400 ppm mesitylene, control blood concn was (75.8 + or - 2.1) x 10-6 mol/l vs 68.8 + or - 7.8) x 10-6 mol/l at 4000 ppm ethyl acetate. [Freundt KJ et al; Bull Environ Contam Toxicol 42 (4): 495-8 (1989)] **QC REVIEWED**

Xylenes

XYLENES

Summary

Xylene has been shown to be fetotoxic in rats and mice. In humans, exposure to high concentrations of xylene adversely affects the central nervous system and irritates the mucous membranes.

Background Information

Xylene has three isomers, o-, m-, and p- xylene. These three generally have similar chemical and biological characteristics and therefore will be discussed together.

CAS Number: Mixed: 1330-20-7

m-Xylene: 108-38-3 o-Xylene: 95-47-6 p-Xylene: 106-42-3

Chemical Formula: C₆H_A(CH₃)₂

IUPAC Name: Dimethylbenzene

Important Synonyms and Trade Names:

Mixed xylene: Dimethylbenzene, xylol

m-Xylene: 1,3-Dimethylbenzene, m-xylol o-Xylene: 1,2-Dimethylbenzene, o-xylol p-Xylene: 1,4-Dimethylbenzene, p-xylol

Chemical and Physical Properties

Molecular Weight: 106.17

Boiling Point: Mixed: 137-140°C

m-Xylene: 139°C o-Xylene: 144°C p-Xylene: 138°C

Melting Point: m-Xylene: -48°C

o-Xylene: -25°C p-Xylene: 13°C

Specific Gravity: 0.86

Solubility in Water: 160 mg/liter at 25 degrees Celsius

Xylenes Page 1 October 1985 Solubility in Organics: Soluble in alcohol, ether, and other organic solvents

Log Octanol/Water Partition Coefficient: 3

Vapor Pressure: 10 mm Hg at 25 degrees Celsius

Vapor Density: 3.7

Flash Point: 25 degrees Celsius (closed cup)

Transport and Fate

volatilization and subsequent photooxidation by reaction with hydroxyl radicals in the atmosphere are probably important transport and fate processes for xylene in the upper layer of soil and in aquatic environments. Products of the hydroxylation reaction include carbon dioxide, peroxyacetylnitrate (PAN), and cresol. Xylene binds to sediment in water and to organics in soils, and undergoes microbial degradation. Biodegradation is probably the most important fate process in both soils and in the aquatic environment. Xylenes have been shown to persist for up to 6 months in soil. Because of their low water solubility and rapid biodegradation, xylenes are unlikely to leach into groundwater in high concentrations.

Health Effects

The National Toxicology Program (NTP) is testing xylene for carcinogenicity by administering it orally to rats and mice. Although the results have not been finalized, it does not appear to be carcinogenic in rats. Results have not been reported for mice. Xylene was found not to be mutagenic in a battery of short-term assays. Xylene was not teratogenic but has caused fetotoxicity in rats and mice. Acute exposure to rather high levels of xylene affects the central nervous system and irritates the mucous membranes. There is limited evidence of effects on other organ systems, but it was not possible to attribute these effects solely to xylene as other solvents were present. The oral LD₅₀ value of xylene in rats was 5,000 mg/kg.

Toxicity to Wildlife and Domestic Animals

Xylene adversely affected adult trout at concentrations
as low as 3.6 mg/liter in a continuous flow system and trout

Xylenes Page 2 October 1985

W.C. Eastin, NTP Chemical Manager; personal communication, 1984.

fry avoided xylene at concentrations greater than 0.1 mg/liter. The LC₅₀ value in adult trout was determined to be 13.5 mg/liter. LC₅₀ values for other freshwater fish were around 30 mg/liter in a static system, which probably underestimated toxicity. Only a few studies have been done on the toxicity of xylene to saltwater species. These indicated that the m- and o-xylene isomers probably have similar toxicities and are probably less toxic than p-xylene, and that saltwater species are generally more susceptible than freshwater species to the detrimental effects of xylene (LC₅₀ = 10 mg/liter for m- and o-xylene and LC₅₀ = 2 mg/liter for p-xylene). However, it should be stressed that these generalizations are based on results from limited data.

No information on the toxicity of xylenes to terrestrial wildlife and domestic animals was available in the literature reviewed. However, because of the low acute toxicity of xylenes it is unlikely that they would be toxic to wild or domestic birds and mammals.

Regulations and Standards

NIOSH Recommended Standards (air): 435 mg/m 3 TWA 870 mg/m 3 /10 min Ceiling Level

OSHA Standard (air): $435 \text{ mg/m}^3 \text{ TWA}$

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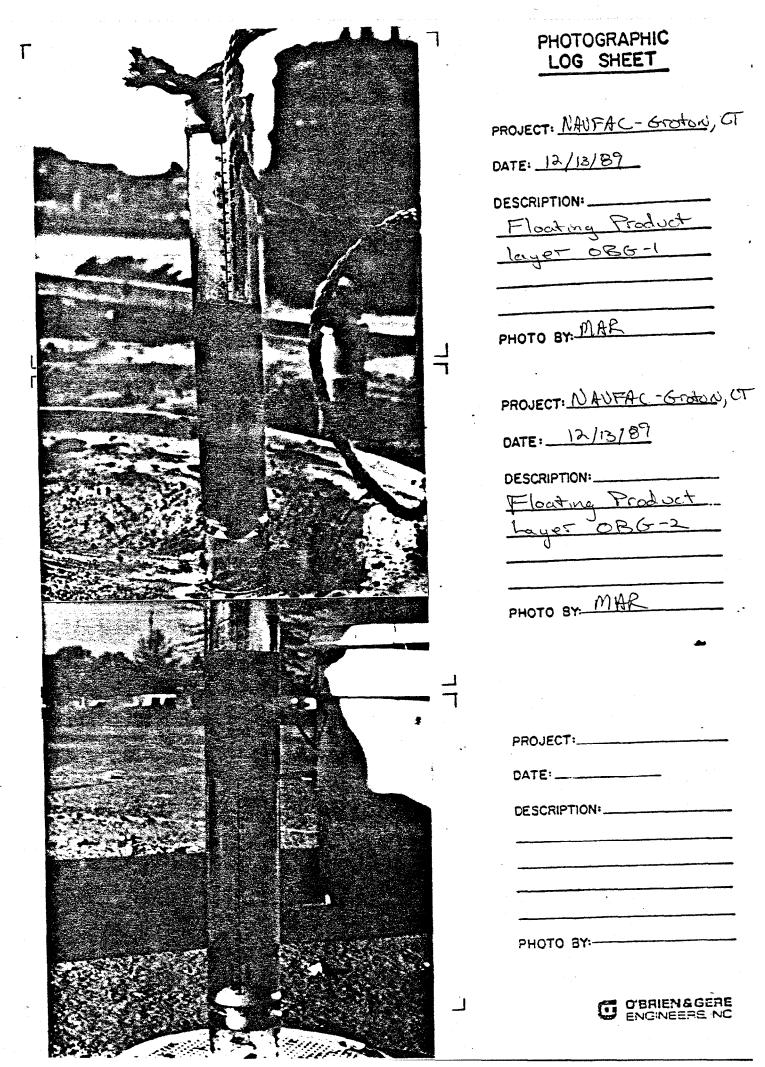
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APPENDIX I FREE PRODUCT RECOVERY INFORMATION





O'BRIEN & GERE

January 24, 1990

Commanding Officer SUBMARINE BASE NEW LONDON Groton, CT 06349-5000

Attn: Mr. Bill Mansfield (Code 803/WM)

Re:

Submarine Base New London,

Passive Gasoline Recovery

System

File: 1862.023

Dear Mr. Mansfield:

Enclosed is the information on the passive recovery system I mentioned in our last telephone conversation. The information is self-explanatory. Auto-Skimmer removes the free phase petroleum layer by skimming the water surface, it doesn't depress the water table. This passive system can be used with the present 2" ID monitoring wells, OBG-1 and OBG-2. We feel a passive recovery system may remove a substantial amount of free phase gasoline from wells OBG-1 and OBG-2 due to the height of the product present in these wells and the lack of draw down shown by these wells during previous sampling operations at the site. An active recovery system would required the drilling of an 18" ID hole and installation of a 12" ID recovery well. This system can be delivered in a week, as these units are presently in stock at the vendor's warehouse. This system is mobile; note the picture where one average size man moves the auto skimmer. system needs a 15 amp, 115v power source and can be delivered with 2 float switches that will be inserted into two separate 55 gallon drums used for oil and wastewater collection. The float switches allow unsupervised operation of the unit. When the water level or oil level in either 55 gallon drum contacts either float switch, the auto skimmer shuts off. The auto skimmer also contains a 15 gal oil/H,O separator.

Costs include:

- Rental cost of Auto-Skimmer

\$ 1,400/mo.

140/mo.

- Rental cost of Winter blanket (prevents water handling parts from freezing; optional)

Mr. Bill Mansfield January 24, 1990 Page 2

- Freight transportation to Groton, CT (round-trip) \$ 500
- Unit decontamination upon return to vendor \$ 200

The unit is delivered by common carrier (i.e., Roadway, tractor-trailers) and a fork lift would be needed to remove the approximately 650 lb. unit form the rear of the truck.

The vendors have said that start-up is easy, so that the unit start-up can be performed without the need for vendor technicians to be present. If necessary we can get telephone assistance from vendor representatives. For a vendor representative to be present for start-up would cost an extra \$500/day and expenses from port-to-port. The unit comes with a warranty in case maintenance is needed. For maintenance covered by the warranty (e.g., maintenance not considered as originating from mistreatment of the unit) a technician will be supplied by the vendor at no charge.

Very truly yours,

O'BRIEN & GERE ENGINEERS, INC.

Clay Wallace-Reilly

Design Engineer

CWR: WWW004

Enclosure

cc: T.A. Jordan

E.P. Zimmerman

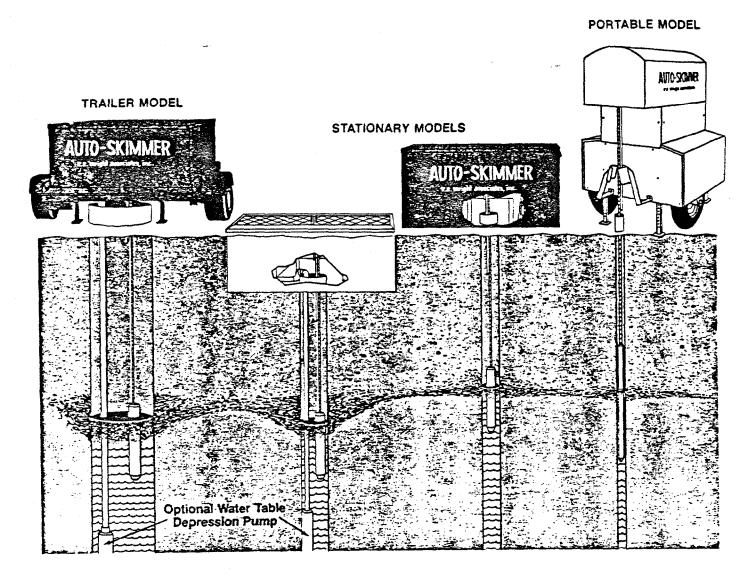
R.G. Stromberg

B. Helland (NORTHDIV)

M.A. Randazzo

AUTO-SKIMMER TM Palented-U.S No. 4 404 093

Operational Versatility



Four Types of Installation Available

The standard **Portable Model** Auto-Skimmerse (far right, above) can be wheeled easily from well to well and set up in less than 20 minutes. In addition to this standard model, the Auto-Skimmerse is now available in two other models: the **Trailer Model**, which can be towed from site to site on the open road, and the **Stationary Model**, which can be installed above or below grade in an enclosure 40 inches wide by 50 inches long by 24 inches high or deep.

In addition to the standard construction, which is compatible with most petroleum products and fresh groundwater, all three models are available in **Corrosion Resistant Construction** for aggressive water environments, or **Chemical Resistant Construction** for recovering industrial chemicals and solvents.

All Models Operate in Any Diameter Well, Sump or Manhole

Because of its unique design, all models of the Auto-Skimmer can effectively recover product from any well, sump or manhole with a diameter of two inches or greater. Where a water table depression pump is desired, it may be used in conjunction with the Auto-Skimmer, in wells that are four inches in diameter or larger.

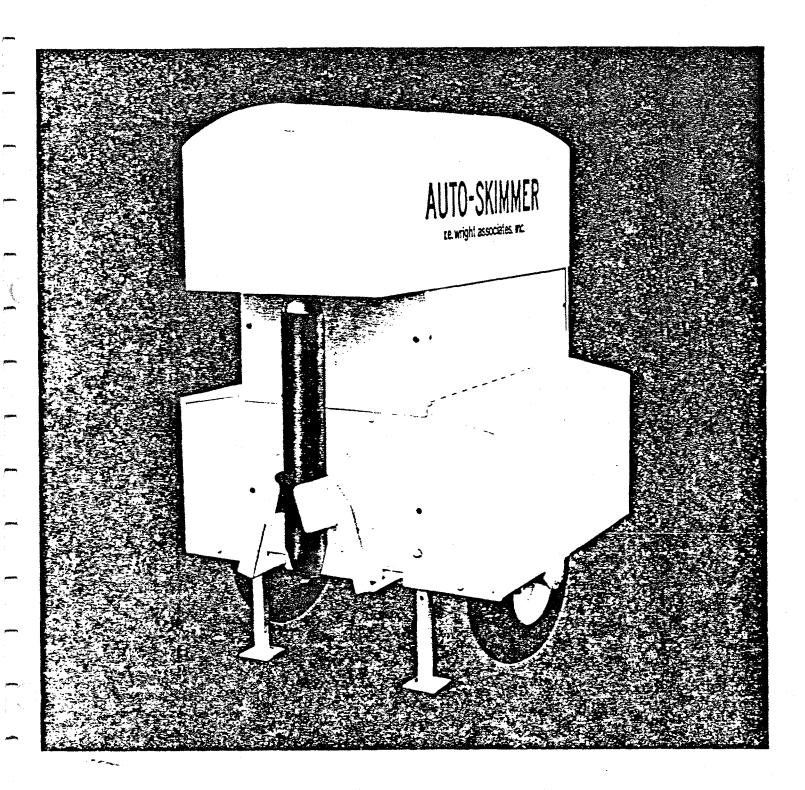
All models can be easily modified in the field to fit any well diameter from several feet down to two inches in less than 30 minutes.

This extreme versatility to quickly and easily access wells of different diameters provides great flexibility to any recovery program. Recovery centers may be changed with no lost time or additional well construction expense by utilizing observation wells for recovery. The Auto-Skimmer, may also be periodically rotated among various recovery wells and observation wells to improve the recovery efficiency.

AUTO-SKIMMER

Automatic Recovery of Floating Hydrocarbons

From Water Wells



AUTO-SKIMMER TM Palentes - L S No 4 404 093

Recovers up to 6000

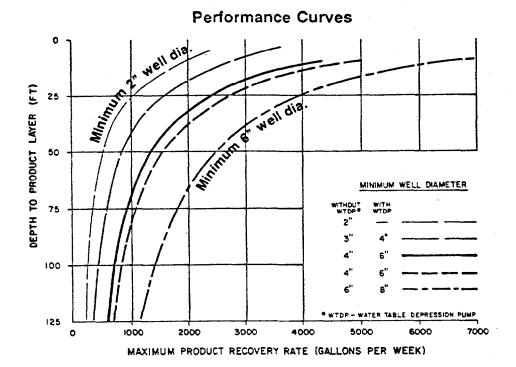
gallons per week

Recovery Capability

The maximum recovery rate of the Auto-Skimmer is a function of the well diameter and the depth to the product layer as illustrated by these performance curves. However, the actual long term recovery rate of a given well will be governed by the product yield of that

Product Transfer

The integral oil/water separator automatically transfers recovered product to an adjacent drum or tank under a maximum discharge pressure of 10 psi. If greater product discharge pressures are required, an auxiliary product discharge pump is provided.



Automatically Adjusts to Changing Liquid Level

Because it mechanically senses the buoyancy of the empty recovery vessel as it becomes partially submerged, the Auto-Skimmer-will lower the vessel until it automatically locates the liquid level each time it enters the well. As this function is mechanical, there is no reliance on electrical probes, which tend to become coated with hydrocarbons and malfunction. Instead, Auto-Skimmer's mechanical system reliably adjusts to any change in liquid level resulting from tidal, seasonal, or storm events; even periodic cycling of pumps in nearby wells, or an optional water table depression pump in the same well.

Additionally. Auto-Skimmer's ability to automatically locate the liquid level saves considerably on time and cost when moving from well to well, since no adjustments are required for any variation in the depth to the product layer.

Continuous Recovery Mode

Auto-Skimmer-, offers a continuous recovery mode for high rates of free product entry into the well. Activated by a single switch on the Master Control Panel, the recovery vessel will continuously travel in and out of the well, pausing only to skim product and for its contents to be pumped into the separator. As the recovery capability of the Auto-Skimmer- in continuous recovery mode, typically exceeds the product yield of the well, product will be removed as rapidly as it accumuiates in the well.

Timed Recovery Mode

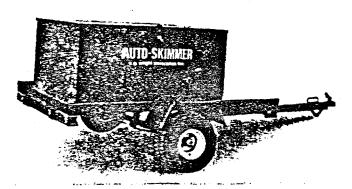
When the product yield of the well is low compared to Auto-Skimmers' maximum recovery rate in continuous run, the unit may be operated in a timed recovery mode. Under this operating mode, any time delay of several seconds to thirty hours between skimming cycles may be selected.

Timed recovery mode is an option which provides for the efficient removal of small quantities of product while mantaining the water surface in an essentially product-free condition. This mode of operation may be selected a mply by turning the continuous recovery mode switch off, and setting the timed recovery mode timer to the desired interval.

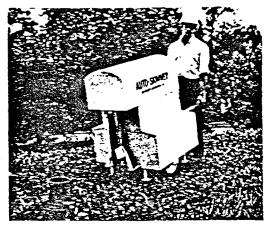
- AUTO-SKIMMER TM Palenied-US No 4 404 093

Portable • Completely Automatic Recovery

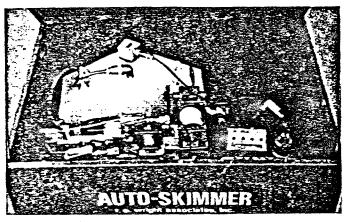
Explosion Proof Electrical Components



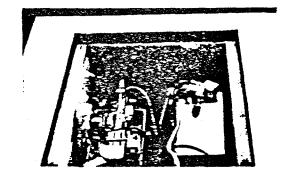
TRAILER MODEL



PRIABLE MODEL



STATIONARY MODEL



STATIONARY MODEL (below grade installation)

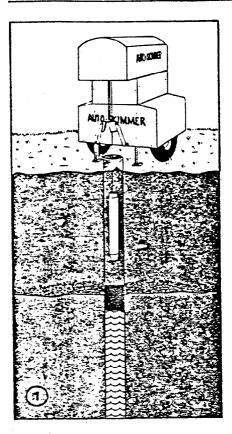
AUTO-SKIMMERwis The Practical Alternative to expensive large diameter recovery wells, clogging filters, fouling probes and expensive maintenance that escalate the costs of your recovery program.

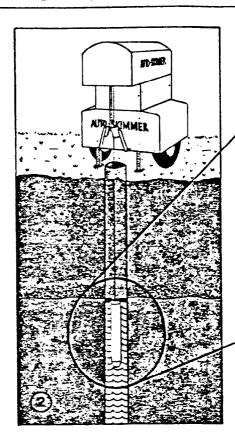
OPERATING ADVANTAGES OF THE AUTO-SKIMMER-

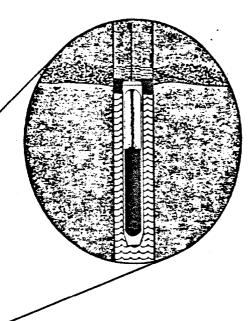
- Recovers up to 6,000 gallons of product per week from wells, sumps, and manholes with diameters ranging from many feet down to two inches.
- Works with or without a water table depression pump.
- Automatically adjusts to changing water levels due to tidal, seasonal or pumping cycles.
- Operates without complicated and expensive downhole filters or probes.
- Works equally well in products ranging from gasoline to No. 4 fuel oil.
- Installs in less than 20 minutes.
- Leaves no measurable free product on the water surface.

AUTO-SKIMMER TM "Patented-US No 4 404.093

Automatic Skimming Cycle







Pulsing action can be set to as little as 1/8" intervals to allow for efficient skimming of even small product thickness.

Operating Principle

- (1.) The control mechanism automatically lowers a recovery vessel into the well until it has partially entered the liquid, and becomes slightly buoyant.
- (2.) The weight change resulting from the bouyancy causes the control mechanism to begin lowering the recovery vessel in a series of short pulses, pausing momentarily at each interval to permit the smooth skimming of free product over the slightly submerged rim of the vessel.
- (3.) When the recovery vessel is approximately 3/4 full, the unit mechanically senses its increased weight and automatically raises the vessel before it overfills.
- (4.) Upon return of the recovery vessel to the surface, its contents are automatically pumped into the built-in oil/water separator from which the product is simultaneously pumped to a collection tank, and water is either returned to the well, or to surface disposal.

